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RECORDS OF REVISION

<u>Rev.</u>	<u>Date</u>	<u>Description</u>	<u>POC</u>	<u>OIC</u>
0	6/29/99	Document rewritten and reformatted to support LIR 220-03-01, Facility Engineering Manual. This chapter supersedes LANL Facility Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Acronym list deleted and National Standards referenced; definition section added; symbol legends created & numbered; drawing revision procedures expanded.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>
2	7/15/02	Minor Changes: Editorial changes for correction/clarification throughout, as indicated by revision bars. Additions to "General Definitions."	Richard Trout, <i>FWO-SEM</i>	Kurt Beckman, <i>FWO-SEM</i>
3	9/16/04	Minor editorial changes as noted with margin bars; changed LEM to the Engineering Standards Manual (ESM).	Richard Trout, <i>FWO-DECS</i>	Gurinder Grewal, <i>FWO-DO</i>

PLEASE CONTACT THE RESPONSIBLE ENGINEERING STANDARDS POC AND COMMITTEE
for upkeep, interpretations, and variance issues

LDM	Drafting Manual POC
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100 GENERAL REQUIREMENTS

101 INTRODUCTION

The purpose of the LANL Drafting Manual is to establish a formal system of drafting requirements required by LIR220-03-01, Engineering Standards for LANL personnel, contractors, and subcontractors for nuclear and non-nuclear facilities. Use of this manual is required when creating or modifying drawings for LANL facility projects and preparing revisions (typical facility systems are defined by the [Engineering Standards Manual](#), Chapter 1 Section 210). Use of this manual is recommended for programmatic work, where appropriate. This manual does not address weapons or machined parts work covered by ESA Division procedures. For these types of designs, use the Global Engineering Manual by Jerome H. Lieblich, Drawing Requirements Manual – 10th ed. <http://drm.lanl.gov/>, and ESA procedures where applicable.

This manual provides minimum requirements for applying drafting concepts to both the initial development of drawings and their subsequent modification. The requirements of this manual apply to new drawings **only** (doesn't force updating of existing drawings). One **exception** is the case of revisions, for which Section 103 applies. The information contained herein is by no means all encompassing; however, this manual does present enough information to provide the user with a fundamental working knowledge level sufficient to understand the concepts presented. The manual web address is:

<http://www.lanl.gov/f6stds/pubf6stds/draftman/dmindex.htm>

The October 2001 revision of this manual introduced reliance upon the National CAD Standard (NCS) for some requirements. AEs and others will be required to purchase the NCS from www.nibs.org

Notes: 1) All stated fonts are AutoCAD. 2) Guidance statements (as apposed to requirements) appear in italics or are clearly indicated as such.

1.0 ACRONYMS

Acronym	Description
ACI	American Concrete Institute
ADC	LANL Authorized Derivative Classifier
AE	Architectural Engineer
AISC	American Institute of Steel Construction Inc.
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
CSI	The numbering and 3-part format defined by the Construction Specifications Institute's MasterFormat and SectionFormat documents.
D	Delta

Acronym	Description
DCP	Design Change Package
DCRM	Document Control & Records Management Team [FWO]
DECS	Design Engineering & Construction Services Group [FWO]
ECN	Engineering Change Notice
ERD	Evacuation Route Diagram
ESA	Engineering Sciences and Applications Division
ESM	(LANL) Engineering Standards Manual
FCN	Field Change Notice
FPR	Floor Plan of Record
FWO	Facility & Waste Operations Division
I&C	Instrumentation and controls
IBS	Integrated Business Systems Group [FWO]
ISA	Instrumentation Systems and Automation Society
L	Length
LANL	Los Alamos National Laboratory
LPS	Lightning Protection System
NCS	National CAD Standards
NFPA	National Fire Protection Association
NMSPC	New Mexico State Plan Coordinate System ??
P&ID	Piping and Instrumentation Diagram
PC	point of curvature
PFD	Process Flow Diagram
PI	point of intersections
PT	point of tangency
R	Radius
RPR	Roof Plan of Record
ST	standard drawing

Acronym	Description
T	Tangent
UDS	Uniform Drawing System
VPC	vertical point of curvature
VPI	vertical point of intersection
VPT	vertical point of tangency

2.0 ACRONYM AND ABBREVIATION USAGE ON DRAWINGS

- A. System and component name acronyms (“IDs”) shall be per ESM Chapter 1. Other abbreviations shall comply with ASME Y14.38, Abbreviations and Acronyms, or the NCS (which includes the CSI Uniform Drawing System [UDS]). Use the same system throughout drawing set. Minimize the use of acronyms whenever possible.
 1. The referenced standard for abbreviations is not intended to be a complete listing of all possible abbreviations required for a project. If additional abbreviations are required, use standard industry abbreviations. An abbreviation legend is required for abbreviations used in the drawing set that are not referenced in the LANL Drafting Manual.
- B. Do not abbreviate single words with four letters or less, except for some very commonly used abbreviations such as:

& and
 @ at
- C. Avoid using abbreviations with more than one meaning except where they occur in different disciplines or when used in a context that makes the meaning unequivocally clear.
- D. In general, write abbreviations in capital letters with no lower case letters or punctuation (except H₂O, CO₂, etc.). Use punctuation only when the abbreviation can be interpreted as a word without the punctuation such as: NO. (number). In this case, a period is needed for clarity.

3.0 DEFINITIONS

A. Drawing Sheet Types:

Note: These are used for drawing numbers and set organization (see Section 210).

- **Plans:** Views of horizontal planes, showing components in their horizontal relationship.
- **Elevations, Profiles and Cross Sections:** Views of vertical planes, showing components in their vertical relationship, viewed perpendicular from a selected vertical plane.
- **Sections:** Views of vertical cuts through and perpendicular to components, showing their detailed arrangement.

- **Large Scale Views:** Views of plans, elevations, or sections at a larger scale and with more detail than the referenced view.
- **Details:** Plans, elevations, or sections that provide more specific information about a portion of a project component or element than smaller scale drawings.
- **Diagrams:** (Schematics) Non-scaled views showing arrangements of special system components and connections not possible to clearly show in scaled views (e.g., one-lines, process flow, piping & instrument, grounding, instrument & control, lightning, wiring, riser, etc).
- **Schedules:** Tables or charts that includes data about materials, products, and equipment (e.g., panel schedules, mechanical equipment lists, door and window schedules, submittals).
- **3D Representations:** Perspectives, isometric drawings, and electronic CAD models.

B. Drawing Formats

Note: P&IDs, fabrication, construction, and architectural drawings can be presented using one of several different formats. The standard formats are cutaway, double-line, one-line, and pictorial. Each format provides specific information about a component or system.

Cutaway Drawings: A cutaway drawing is another type of pictorial drawing. In a cutaway, as the name implies, the component or system has a portion cut away to reveal the internal parts of the component or system. This type of drawing is extremely helpful in the maintenance and training areas where the way internal parts are assembled is important. Although not common, these drawings may be ordered by the client upon request. (e.g., 3D representations, diagrams)

Double Line Drawings: Double line drawings present the same type of information as a one-line. Double line drawings are useful in layouts and details where space restrictions and retrofits involve tight installations. (e.g., plans, elevations, details)

Electrical One-Lines: Designed to present functional information about the electrical design of a system or component. They provide the same types of information about electrical systems that P&IDs provide for piping and instrument systems. Electrical one-lines are not drawn to scale. Examples of typical one-lines are site or building power distribution, and motor control centers. (These are sometimes called single-lines.) (e.g., diagrams) See ESM, Chapter 7, example drawing D5000-2 (formerly ST7002).

Pictorial Drawings: Pictorial or double line drawings present the same type information as a one-line, but the equipment is represented as if it had been photographed. It requires much more effort to produce than a one-line drawing and does not present any more information as to how the system functions. (e.g., details, large scale views)

C. Categories of Drawings

Note: These categories are commonly encountered in industry practice and may be referred to throughout this manual. However, drawing sheet numbering is based upon drawing sheet types defined by subpart 2.0A herein.

As-Built: Documentation (for example, Piping and Instrumentation Diagrams, and database records) verified by physical inspection as depicting the actual physical configuration and verified as consistent with the design requirements.¹

As-Built Process: The process of determining the as-found condition, resolving discrepancies, obtaining approval from the design authority, and producing the as-built documentation.

As Found Drawing: Information, often in the form of marked-up documents that reflects the actual physical configuration and identifies any discrepancies with currently-approved facility documentation.¹

Assembly Drawings: The assembly drawing is an “exploded” perspective of the object with all the components shown as they go together. This type of pictorial is usually found in vendor manuals and is used for part identification and general information relative to the assembly of the component. Although not common for facility work, these drawings may be ordered by the client upon request. (e.g., 3D representations, diagrams)

Construction (Physical) and Architectural Drawings: Designed to present the detailed information required to construct or fabricate a part, system, or structure. These two types of drawings differ only in their application as opposed to any real differences in the drawings themselves. (e.g., plans, elevations, sections, details, large scale views, double line drawings)

Construction drawings (commonly referred to as “blueprint” drawings), present the detailed information required to assemble a structure on site.

Architectural drawings present information about the conceptual design of the building or structure. Examples are building plans, building elevations (outside view of each side of a structure), equipment installation drawings, foundation drawings, and equipment assembly drawings.

Electrical Schematics: Designed to provide more interconnection information about an electrical component than the one-lines. Electrical schematic drawings present information such as the individual relays, relay contacts, fuses, motors, lights, and instrument sensors. Examples of typical schematics are valve-actuating circuits, motor starter circuits, and breaker circuits. (e.g., diagrams) See ESM, Chapter 7 example drawing D5020-1 (formerly ST7008).

Instrument Loop Diagrams: Are an extension of P&IDs, and illustrate control philosophy and confirm the completeness of submitted data in design, construction, startup, operation, maintenance and modification. For an example, refer to ISA 5.4. These diagrams will be located in the mechanical discipline, 6000 series, Section 211 of this manual.

Isometric Projection: The isometric projection presents a single view of the component or system. The view is commonly from above and at an angle of 30 degrees. This provides a more realistic three-dimensional view. This view makes it easier to see how the system looks and how its various portions or parts are related to one another. Isometric projections may or may not be drawn to a scale. (e.g., 3D representations)

1 DOE STD-1073-93.

Logic Diagrams: Logic diagrams can be used to depict several types of information. The most common use is to provide a simplified functional representation of an electrical circuit. It is easier and faster to figure out how a valve circuit works using logic symbols versus using the electrical schematic with its complex relays and contacts. These drawings do not replace schematics, but they are easier to use for certain applications. (e.g., diagrams) For an example refer to ISA 5.2. These diagrams will be located in the electrical discipline, 6000 series, Section 211 of this manual.

Orthographic Projections: Orthographic projection is widely used for components and assemblies. Orthographic projections present the component or assembly through the use of three views. These are a Top view, a Side view, and a Front view. Other views, such as a bottom view, are used to more fully depict the component or system when necessary. (e.g., 3D representations)

Piping and Instrumentation Diagrams (P&ID): Designed to present functional information about a system or component. Piping configuration, flowpaths, pumps, valves, instruments, signal modifiers, and controllers are represented on P&IDs; flow diagrams do not show instrumentation. These drawings are not drawn to a scale and present only the relationship or sequence between components. Common synonyms for P&IDs include EFDs (Engineering Flow Diagrams), UFDs (Utility Flow Diagrams) and MFDs (Mechanical Flow Diagrams. For an example, see ESM Mechanical Chapter Section D10-30PFD and example drawings M-6030 and M-6040-6042).

Priority Drawings: Priority drawings include the small set of “upper-tier” design drawings that are necessary to support the safe performance of facility operations, maintenance, and design activities within the facility’s approved safety envelope. These drawings typically include piping & instrumentation diagrams, emergency evacuation maps (e.g., floor plans of record), logic drawings, electrical one-lines, and lightning protection and may include primary and secondary site utility location, and shop and vendor drawings. (e.g., diagrams, plans, 3D representations). [LIR240-01-01, Configuration Management](#), outlines priority drawing guidelines.

Process Flow Diagrams (PFD): PFD’s provide functional information about a system or component. PFDs depict piping configurations, flowpaths, pumps, and valves. Flow diagrams do not show instrumentation. These drawings are not drawn to a scale and present only the relationship or sequence between components. (e.g., diagrams) See ESM Mechanical Chapter Section D10-30PFD and drawings M-6010 and M-6020 for an example.

D. Reference Drawings: General Definitions

General Note: A word, number, phrase, sentence, or group of sentences that is applicable to, involving, related to, or characteristic to, several, a group, many, or the majority involved. See Section 214 for an example.

Geo-spatial Information: data that is referenced by geographic coordinates.

Keyed Note: A word, number, phrase, sentence, or group of sentences that gives specific explanation, identification, or task that provides a solution. See Section 214 for an example.

Sketch (SK): A rough preliminary, draft, or informal drawing that should follow LANL Drafting Manual Standards, but does not involve quality assurance procedures. Sketches are not stand alone documents and are normally associated with Engineering Change Notice, Field Change Notice and Design Change Packages. These sketch packages are only acceptable for building projects and/or project modifications costing up to \$100,000; see Section 103.4 for requirements.

- **Freehand and AutoCAD:**

A rough preliminary, draft or informal drawing, sketched well enough to be understood by others. The sketch shall be neat, simple, and the message clear. The sketch may be drawn on any size or type of reproducible and achievable medium, (8.5x11, 11x17, etc.) and attached to an ECN, FCN or DCP document for later upgrading to standard electrical drawings or existing electronic drawings per LANL Drafting Manual. Sketches may contain Plans, Elevations, Orthographic (3D), Dimensions, and Notes to concisely convey the idea. The information on the sketches may be shown in any order and on any page and disciplines may be mixed. In an AutoCAD sketch, the line types, colors, fonts, and symbols shall conform to the LANL Drafting Standards.

Plate (PL): A graphic representation similar to a sketch in that it is associated with Engineering Studies, Conceptual Design Reports, Conceptual Design Plans (CDP), and/or Design Criteria (DC). Sketches can be provided as a construction documents. A plate is conceptual in nature and is not used for construction.

Floor Plan of Record (FPR): The controlled set of architectural drawings identifying structural, electrical, mechanical, HVAC, and layout for a building. The FPR is used as a baseline priority drawing for developing Emergency Evacuation Plans, Space Planning and Management, Interior Design, geo-spatial information for the Geographic Information System (GIS), and Title II design. This is the “drawing of record” upon which the Authorization Basis of the building is based.

Standard Drawing (ST): A LANL produced formal drawing depicting standard details to provide a consistent method of construction and installation of equipment for all disciplines and achieve standardization in a record drawing set. These are on-line in the various Engineering Standards Manual Chapters.

Title I (Preliminary design): Design services that develop and evaluate the existing conditions, proposed system and facility changes, and confirm the most economical design approach to be completed in Title II (see below), which meets established design requirements. Elements of a Title I document include:²

- a) preparation of a modification book;
- b) evaluation of alternatives;
- c) preparation of preliminary design calculations;
- d) vendor evaluation and pricing recommendations;
- e) development of outline construction specifications;
- f) preliminary design installation layouts;
- g) P&IDs;
- h) electrical one-lines;
- i) block diagrams;
- j) general framing plans;
- k) construction estimate;
- l) schedule and sequence completion of the Title I Design Summary; and
- m) a preliminary DIS (design information summary) for each system.

Title II (Definitive design): Design services that finalize the Title I design, with particular emphasis on working within existing conditions, minimizing system and facility changes, and confirm the most economical construction approach which meets established design requirements. Elements of a Title II document include:

- a) preparation of detailed design calculations;
- b) vendor evaluation and pricing recommendations;
- c) **accurate** design installation layouts with tolerances specified;
- d) P&IDs;
- e) construction cost estimate;
- f) schedule and sequence;
- g) electrical one-lines;
- h) framing plans;
- i) equipment schedules;
- j) test and inspection plans;
- k) construction specifications; and
- l) project turnover/closeout documentation.

² DOE Order 4700.1.

102 PLANNING AND COMPOSITION OF DRAWINGS

1.0 GENERAL FORMATTING GUIDELINES

- A. *Proper planning and presentation of the drawing sheets is very important. Make every effort to anticipate and plan for the drawing space layout now and for future modifications: the symbols required, use of consistent terminology, and coordination of disciplines.*
- B. *Map space in advance for each plan, section, elevation, detail, schedule, etc.*
- C. *Each design group should develop a process for in-house design verification that is a formal documented procedure for ensuring technical reviews for drawings: development, design, change and regulatory compliance. Drafts could be controlled by letter revisions, e.g.: **Revision A** - research and layout; **Revision B** - walkdowns and design; **Revision C** - engineering overlay; and **Revision D** - final review.*

2.0 GENERAL FORMATTING REQUIREMENTS

- A. Arrange each drawing so that it will not appear unbalanced or crowded.
- B. Use drafting conventions that are clear, uniform and easily understood.
- C. Use drafting conventions that are clear and readable, when the sheet is reduced to half size (e.g., D size to B size).
- D. Use consistent line widths, text height, and line types in a drawing set for clarity and accuracy.
- E. Do not combine different disciplines or systems on the same drawing sheet.
- F. Show or call out information the least number of times possible, preferably once.
- G. Coordinate embodiments, inserts, block-outs, and penetrations with all disciplines to ensure that the drawing set conveys consistent information.
- H. Use terminology in the drawing set that is consistent with the terminology in the related specifications and throughout the drawing set.
- I. Vendor drawings may be part of a document drawing set, but are used only as reference drawings used for fabrication, installation, or as-built by the vendor. These drawings do not need to conform to the LANL Drafting Manual and are to be labeled as “reference drawings” 1/4 inch text height located to the left of the Title Block.
- J. Do not show calculations in the drawing set unless otherwise noted in this manual.
- K. Put room numbers on all building plan drawings.
- L. Do not hide, overlap or conceal text in hatching, line types, symbols, etc.

- M. Do not combine sheet types on the same drawing sheet unless otherwise specified in this manual.
- N. Eliminate useless data that can be reproduced endlessly.
- O. Dimension styles shall be consistent within each discipline.
- P. In instances where software conflicts occur with AutoCAD formatting (e.g., LANL UMAP, LANL survey drawings), the drawings must follow as closely as possible formats outlined in this drafting manual. In order for this to occur, the Drafting Manual POC must have a written agreement with the producer of the drawings (i.e., Grandfather clause in effect). Fonts and text styles should be matched as close as possible and text placement must not interfere with lines in drawings as outlined in Sections 102.2, 212, and 213.

Note: When design agencies use drawings generated by firms that have grandfather clauses in effect, it is the responsibility of the AE firm to inform the Drafting Manual POC of where the drawings originated, place a general note on each affected drawing explaining origin of base map.

3.0 DRAWING LEGEND

- A. Provide a standard legend of symbols and line treatment on the first drawing sheet of each discipline for the drawing set.

Note: A drawing legend will occur on the first sheet for each discipline identified by the discipline designator, followed by a “ - ” then followed by numerical sequence (e.g., A-0001), see Table 211-1.

- B. Symbols used in the drawing package that do not appear in the standard LANL symbol library shall be identified on the symbol legend in the drawing set, by using the letters “NS” (non-standard) enclosed in parenthesis to the right of the symbol description.
- C. The drawing legend should be developed showing both existing and proposed features. Legends that show the same symbols for existing and proposed are confusing and make it hard to read the drawing. This includes proposed and existing line types.
- D. For information on the location of General Notes. See Section 214.9B.

103 DRAWING REVISIONS

1.0 DRAWING REVISION

Guidance: For existing facility modifications, designers shall make every effort to locate and revise existing drawings rather than create new drawings that result in unnecessary effort and documentation issues.

- A. If a drawing is an initial issue, enter a “Rev. 0” in the revision block located within the drawing title block and issue for sign-off during final submittal.

- B. Indicate revisions by numbers, beginning with the number “1.” Use a sequential number for each revision on a sheet.
- C. Number each revised sheet independently.
- D. Enter the appropriate information in the revision block of the drawing title block.
- E. In the Title Sheet, indicate each revised drawing sheet by drawing a revision cloud around the current revision number shown in the list of drawings “Revision Column,” see Figure 203-1, Item 15.
- F. Use the AutoCAD “cloud” (or other similar graphic symbol) command for revisions (layer-cloud, color- white, pen weight 0.35 mm, line type-continuous) to completely encircle the revised drawing elements. On subsequent revisions, delete the previous revision clouds. A revision cloud is illustrated in Figure 103-1.
- G. A revision cloud is not required on a drawing sheet if the whole sheet was revised or it is a new sheet added to the drawing set.
- H. Indicate the current revision number in the “NO.” column of the revision block and “REV.” block of the drawing title block (Figure 103-1).
- I. Indicate the current revision date in the “DATE” column of the revision block.
- J. Hand written initials or signatures are not required in the drawing title block or on previous revision block entries, but are required in the revision block for the current revision.
- K. The following are graphic examples of the Title Block modifications required and Sample Cloud when revisions have been made on a Drawing sheet.

2	5-6-03	U	MN	ECN-3-410-00007 RELOCATE EXHAUST FAN FE-4	DM	AT	MN	MN	GL
1	1/1/00	U	MN	ADDED EXHAUST FAN IN RM 101	DM	AT	MN	MN	GL
NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DES	CHKD	SUB	APP

DRAWING NO	REV
C76391	2

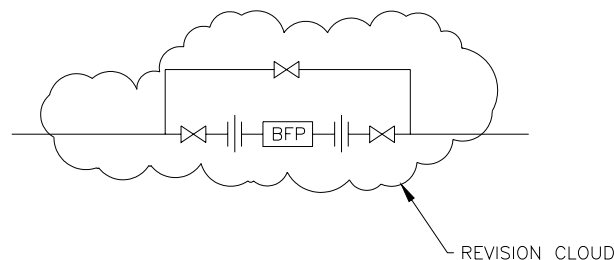


Figure 103-1

- L. Non-electronic drawings with major changes (affecting 50% or more) shall be completely upgraded electronically following the current LANL Drafting Manual.
- M. Modify electronic drawings per the following criteria:
 - The existing As-Built drawing on file shall be revised whenever possible (versus generating a new drawing for a modification or suite of modifications).
 - If the proposed modification requires more space than is provided on the existing drawing, the following options, listed in order of descending preference, shall be followed:
 1. Generate new drawing that **supersedes** an existing drawing, and cancel the **superseded** drawing, **OR add a general note** on the new drawing indicating the supercede drawing C#, title, PI #, and date.
 2. Generate new drawing that **augments** the existing drawing, and cross-reference the drawings to each other, with an explanatory Note above the Title block of both the original drawing and all augmenting drawings, providing a clear identification of and cross-reference to the original drawing.
 - Minor changes (affecting less than 30%) can be modified using the existing drawing format and symbology and current revision procedure.
 - Major changes (affecting more than 50%) shall be completely upgraded to the current standards and depict the area changed by the revision.
 - Gray area between minor/major (31-49%) changes to a drawing and/or sets of drawings shall be determined by the LANL Project Manager or Drafting Manual POC.

- Revisions to “Priority Drawings,” electronic or non-electronic, shall be generated to the current ESM Drafting Manual.
- N. Projects involving existing facilities and systems: the assigned design agency is required to research and locate all existing drawings pertaining to the project. Contact FWO-DCRM Team or FWO-IIM for the drawing database location. **Note:** All existing drawings may not reside in the DCRM records center. Satellite records centers within the facility(s) may contain the essential documentation. Should this be the case, report these findings to an FWO-DCRM Team representative. These documents shall be collected and entered into the LANL master document database.
- O. Revisions to existing drawings with an assigned PI# which are revised under a different PI# shall be noted in the revision block by the new PI# assigned to that change.
- P. Use the Integrated Facility Management Program (IFMP) Administrative Procedure, AP-ENG-002, Developing and Revising a Design Change Package; or AP-ENG-003, Developing and Revising an Engineering Change Notice. The ECN or DCP number shall be posted in the revision section of the drawing title block (Figure 202-2 item #4).
- Q. Submit all ECN and DCP documentation to FWO-IBS DCRM Team with the final revised drawings (*LANL MS M703 or hand-deliver to DCRM at TA-3-410 (becoming TA-63-121)*).
- R. An ADC must review, classify, and sign each revision.
- S. DCP/ECNs with sketch attachments may also include revised existing drawings associated with the document package. Provide proper information for cross-referencing data.

2.0 AS-BUILT AND AS-FOUND REVISION

Note: “As-Built” vs. “As-Found” - “As-Built” drawings have a pedigree: a paper trail documenting justification/rationale for each modification made; “As-Found” drawings reflect actual field configuration for which there is either:

- no documentation, or
- complete documentation is lacking

Follow Section 1.0 with the following additional requirements in order to revise an As-Built or As-Found drawing:

- A. Delete all revision clouds from the drawing sheet.
- B. Do not use revision clouds to denote As-Built or As-Found changes.
- C. Enter the next sequential revision number in the drawing title block. Enter that same number in the revision block.
- D. In the “REVISION” column of the revision block enter either “As-Built (or As-Found) With Changes,” or “As-Built Without Changes,” if there were no red-lines to incorporate (Table 202-1, Item 4 “Revision Description” of this manual).

- E. A detailed description of the “As-Built” (or As-Found) changes is not required; however, the date of origination is required.
- F. Once the as-built drawing is complete, convert all existing features on the drawing to a 0.35 mm line width and a “continuous” line type. This can be accomplished by using DDLMODES Layer Management. All entities of the drawing (layer, color, line type, etc.), are to be “by layer.” Refer to the AutoCAD Users Guide for procedure. This process ends the construction phase of the project and initiates the operation and maintenance phase.

3.0 TITLE BLOCK DATE STAMP (*GUIDANCE*)

- A. *Newdate is a lisp routine to label a drawing as to it's location on the server, the date it was created or upgraded, the time it was last saved and by whom the file was created by or modified by last. There are two (2) files named (NEWDATE.dwg) and (NEWDATE.lisp) that make the Title block Date Stamp work. To obtain these files, contact lsp@lanl.gov .*

Download the two (2) files into the AutoCAD 20XX\Support directory. Start the AutoCAD program, and under the pull down menu “TOOLS\LOAD APPLICATIONS”, load the NEWDATE.lisp file and add it into the history case.

Upon starting a new drawing, after opening, inserting, or X-Refing a Title Block, insert the drawing file named “NEWDATE” just outside of the title block border on the lower left corner. Type “NEWDATE” and the date stamp should update itself. (See example in Section 203.2, Figure 203-1.)

It is not mandatory that this Date Stamp be used. The stamp is provided as an aid for drawing file management and can be modified to suit.

- B. *This stamp should appear on all drawings.*

4.0 SKETCHES

- A. Sketches are not “stand-alone” documents and must be accompanied with an approved DCP or ECN (refer to AP-ENG-002, Developing and Revising a Design Change Package or AP-ENG-003, Developing and Revising an Engineering Change Notice).
- B. Sketches are used to revise, update or modify an existing condition on existing drawings.
 - 1. May be hand generated or electronically produced.
 - 2. Shall contain all information required to represent a complete design for the project or task. The sketch shall be technically correct, engineered properly and constructible.
 - 3. May be drawn on an “A” to “D” size sheet. (Section 201).
 - 4. Do not require a formal FWO technical design review, but is highly recommended.
 - 5. Shall have a “sketch document tracking number” assigned by FWO-DCRM Team (667-4696).

6. Shall have in the lower right hand corner a section devoted as a title block that will appear on each sketch sheet as a minimum the following information: TA number, Building number, ECN/DCP number (or similar document number per AP-ENG-002 or AP-ENG-003), date of sketch, sketch number and a printed name and signature of responsible engineer approving the engineering change and authorizing the design modification.
 7. Costs related to the ECN/DCP sketches are not to exceed \$100,000 in design and construction. Variances are granted by the Drafting Manual POC when warranted. Any change above the stated dollar amount shall be submitted as a formal design package.
 8. Electronically produced sketches shall comply with the Drafting Manual:
 - a) Section 103, General Requirements (exceptions for E and L).
 - b) Section 201.1, Drawing Sheet Sizes and Format; and 201.5, Grid System.
 - c) Section 204, Plan Orientation.
 - d) Section 205, North Arrow.
 - e) Section 206, Partial Plans.
 - f) Section 208.2, Drawing Scales.
 - g) Section 209, Dimensioning.
 - h) Section 211.2, Priority Drawings.
 - i) Section 212, Line Work.
 - j) Section 213.1, Font Styles and Text Size Requirements.
 - k) Section 214, Elevations, Details, and Callouts.
 - l) Section 215.3, CAD Layering Guidelines.
 - m) Section 301, Symbols.
 9. Hand-produced sketches shall comply with the same Drafting Manual sections except for Sections 208.1, 213.1, and 215.3.
 10. Sketch numbering scheme is not per Drafting Manual, combining disciplines and sheet types are permitted. Numbering scheme is simplified to discipline ID followed by sheet number (i.e., C1, C2,...; S1, S2,...; M1, M2, etc.).
- C. Once construction or as-built modifications have been incorporated, all pertinent documentation (DCP/ECN, sketches, revised drawing [hardcopy and electronic]) shall be submitted to FWO-IBS DCRM Team for document control and records management.
- D. ECN/DCPs with associated drawings and sketches shall be submitted to FWO-IBS DCRM Team for record after construction verification.

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RECORDS OF REVISION

<u>Rev.</u>	<u>Date</u>	<u>Description</u>	<u>POC</u>	<u>OIC</u>
0	06/29/99	Document rewritten and reformatted to support LIR 220-03-01, Facility Engineering Manual. This chapter supersedes LANL Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Drawing size & format defined; added grid reference; title blocks modified for new numbering system; title sheets required, fonts, line widths, text height, line types explained; location plan pinpointed; north symbol generated & location defined; partial & key plans defined; graphic scales defined; drawing scales expanded.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>
2	07/15/02	Minor Change. Editorial changes throughout as indicated by revision bars. Added Section 201 subsection 5.0 Grid System.	Richard Trout, <i>FWO-SEM</i>	Kurt Beckman, <i>FWO-SEM</i>
3	9/16/04	Revisions reflect change from LEM to ESM (Engineering Standards Manual). Moved "Line Width Assignment in Electronic Files to section 212.2.0. Changes/additions to sections 201.2, 202 Table Note (d), 201.4, 208.2, 209.6, 211.1A, and 215.1A. Miscellaneous editorial and Figure modifications throughout as indicated by revision bars.	Richard Trout, <i>FWO-DECS</i>	Gurinder Grewal, <i>FWO-DO</i>

PLEASE CONTACT THE RESPONSIBLE ENGINEERING STANDARDS POC AND COMMITTEE
for upkeep, interpretations, and variance issues

LDM	Drafting Manual POC
-----	-------------------------------------

201 DRAWINGS

1.0 DRAWING SHEET SIZES AND FORMAT

- A. Produce standard construction drawings and individually controlled drawings (priority drawings i.e., PFDs, P&IDs, electrical one-lines, etc.) on a “D” size sheet. (**Note:** LANL has chosen “D” size sheets for ease in reproduction media machinery available and “B” size reproduction use by maintenance and system engineers.)
 - 1. Exception: New facilities with a base floor plan of 50,000 sq. ft. or larger may use “E” size with approval of the Drafting Standards POC prior to design layout.
- B. Produce Engineering Studies, Conceptual Design Reports, and Design Criteria drawings on a “B” size sheet whenever possible.
- C. Use a consistent size of drawing sheet throughout the Drawing Set.

Note: Exception applies to vendor drawings that are attached at the end of the drawing package.
- D. Provide a continuous line sheet border, as illustrated below that is 0.75 mm thick (1 /16 inch).
- E. Standard drawing sheet sizes, borders, and formats are shown below. The overall dimensions are the sheet cut size. (*AutoCAD drawing files for standard LANL title blocks can be downloaded from the LANL Engineering Standards website:*
http://www.lanl.gov/f6stds/pubf6stds/New_Home.html)
- F. *Guidance: An “A” size sheet may be used for sketches for Design Change Packages (DCP), Engineering Change Notices (ECN), etc. The title block should contain the information as in Section 103.4.6 in a format as depicted in Section 202.*

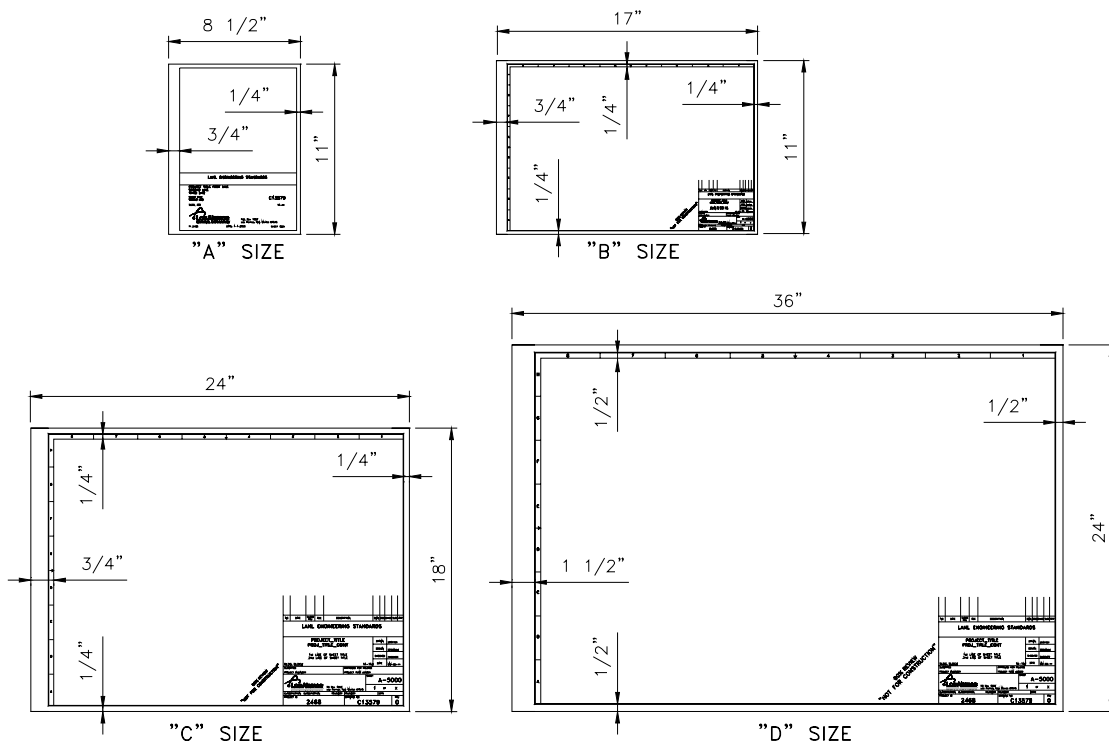


Figure 201-1

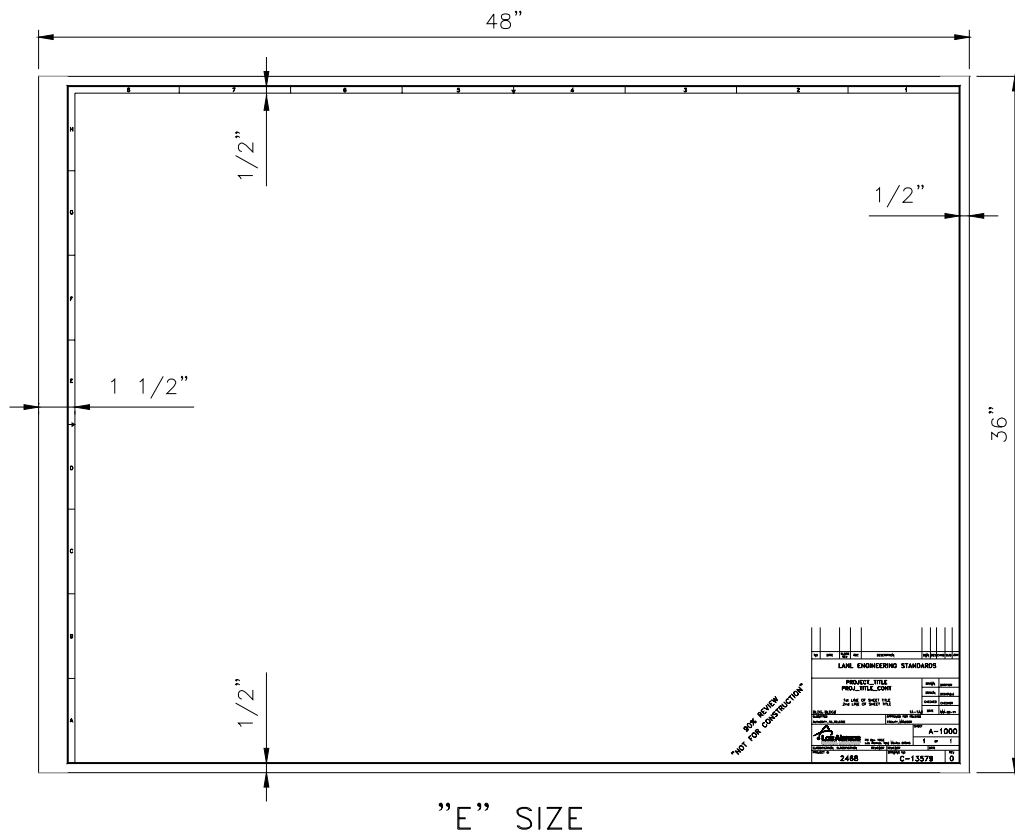


Figure 201-2

- G. "C" and "E" size sheets may be used for special projects not related to 1.0 A and B of this section. LANL project manager shall give guidance for determining sheet usage. (No construction drawings on "E" sized sheets.)

2.0 FINAL DRAWING SUBMITTALS (INCLUDING AS-BUILTS)

- A. All construction drawing design packages and supporting documentation (calculations, specifications, vendor drawings, shop drawings, submittals, T & B, etc.) generated by LANL personnel, contractors, and subcontractors shall be submitted to the FWO DCRM Team Central Records center.
- B. Submit paper prints and electronic files as follows:
1. **Final, approved and stamped paper prints:** Full size, with all required signatures/initials signed off. Use black line on a minimum 0.003 inch paper thickness. Do not use stick-on, appliques, zip-a-tone, etc. on final drawing sheets.
 2. **Electronic files:** Refer to Section 215 for requirements.
- C. Paper prints and electronic files are required for submittal for: final (stamped) design ready "For Construction" and final "As-Built" (after verification of accuracy).

3.0 "NOT FOR CONSTRUCTION" NOTATION

The note "NOT FOR CONSTRUCTION" is to be marked on all in-progress construction drawing sheets in a Construction Drawing Set. Print the review stage (%) above "Not for Construction" and do not remove this notation until the drawings are approved for final release. See symbol block in [Appendix B](#), General.

Appearance	Font	Location
Letter size 1/4 inch	Romand	Left of the title block at a 45-degree angle, read from left to right

4.0 SEALED DRAWINGS

- A. Comply with the LANL Engineering Standards Manual (ESM) [Chapter 1](#), Z10 for the requirements of sealing construction documents.
- B. The location of the Engineer's Stamp (seal) is to the "immediate left" of the title block just above the sheet border (if required).
- C. Revisions to drawings may require an Engineers Stamp. The Engineers Stamp shall appear on the ECN or DCP documentation but not on the drawing or on sketches.

5.0 GRID SYSTEM¹

- A. Grid system is used to indicate structural columns, load-bearing walls, shear walls and other structural elements on the drawings.
- B. Grid lines are used as a basis for dimensioning.
- C. Vertical grid lines shall have designators at the top of the grid lines, numbered from left to right.
- D. Horizontal grid lines shall have designators at the right side of the grid alphabetized from bottom to top.
- E. To eliminate confusion with the numerals 0 (zero) and 1 (one), do not use letters "O" or "I."
- F. In some cases, grid designators may be shown at both ends of the grid line to facilitate references.
- G. Where additional intermediate structural support elements occur between grid lines, a fractional designation is used (e.g., a column occurring at mid-point between grid lines 2 and 3 would be designated as 2.5, a column occurring between grid lines B and C would be represented as B.5).
- H. Show grid lines on layer 5-grid, 0.35 mm (0.015 inches) pen width, pen color 7 (white), centerline line style and with 1/2 inch diameter circles for grid designators.
- I. All disciplines shall use this convention for grid lines.
- J. For existing conditions match existing grid line designators.
- K. Terminate grid lines 1/8 inch from structure.
- L. Designator text size shall be 3/16 inch Romans.

202 TITLE BLOCKS**1.0 GENERAL**

- A. Maintain consistency and accuracy in title block format and content throughout the Drawing Set.

¹ Basis: National CAD Standards.

1. Do not graphically show this border on the drawing.

	8	7	6	5	4	3	2	1
H	<div style="position: relative; height: 400px;"> <div style="position: absolute; bottom: 20px; right: 20px; border: 1px solid black; padding: 10px; width: 150px;"> LOCATION FOR "NOT FOR CONSTRUCTION" AND ENGINEERING STAMP </div> </div>							GENERAL NOTES
O								1. 2. 3.
F								KEYED NOTES
E								<div style="border: 1px solid red; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin: 2px;">1</div> <div style="border: 1px solid red; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin: 2px;">2</div> <div style="border: 1px solid red; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin: 2px;">3</div> <div style="border: 1px solid red; border-radius: 50%; width: 20px; height: 20px; display: flex; align-items: center; justify-content: center; margin: 2px;">4</div>
D								
C								
B								
A								

NO.	DATE	BY	REV.	REVISION	

LANL ENGINEERING STANDARDS

PROJECT TITLE PROJ. TITLE.COMT	SHEET
1/4" LINE OF SHEET TITLE 3/4" LINE OF SHEET TITLE	DATE
BASIC DESIGN STANDARD DRAWING APPROVED FOR RELEASE PROJECT NUMBER	11-11-11 11-11-11 11-11-11 11-11-11
Los Alamos National Laboratory ORGANIZATION, CORPORATION, FIRM, NAME, ADDRESS, CITY, STATE, ZIP	A-5000 1 of 1
CATEGORICAL CLASSIFICATION PROJECT #	NUMBER 2468
C15579	0

C. Only priority drawings (PFDs, P&IDs, Electrical one-lines, etc.) and General Notes/Legends sheets may encroach into the no-draw zone. Note location of General Notes and Keyed Notes.

2.0 TITLE BLOCK FOR CONSTRUCTION DRAWINGS

- A. The standard Title Block for construction drawings is shown in Figure 202-2. See Table 202-1 for legend and description of the required Title Block contents.


①	②	③	③A	④	⑤	⑥	⑦	⑧	⑨
NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DES	CHKD	SUB	APP
⑩ LOGO HERE									
⑪ -----					DRAWN		⑰		
⑫ -----					DESIGN		⑱		
⑬ -----					CHECKED		⑲		
⑭ -----					DATE		⑳		
BLDG. ⑮ SUBMITTED					TA-⑯				
⑳					APPROVED FOR RELEASE ㉑				
 ㉒ Los Alamos National Laboratory PO Box 1663 Los Alamos, New Mexico 87545					SHEET ㉔ OF ㉖				
CLASSIFICATION ㉗					REVIEWER ㉘		DATE ㉙		
PROJECT ID ㉚					DRAWING NO ㉛			REV ㉜	

Figure 202-2

- B. Figure 202-3 is an example of the Title Block for construction drawings.



NO	DATE	CLASS REV	ADC	DESCRIPTION	DWN	DES	CHKD	SUB	APP
 FACILITY & WASTE OPERATIONS SYSTEMS ENGINEERING & MAINTENANCE									
PROJECT_TITLE PROJ_TITLE_CONT					DRAWN D RAFTER				
ONE LINE DIAGRAM AND GROUNDING LAYOUT					DESIGN D ESIGN(s)				
BLDG. 1498					CHECKED C HECKER				
SUBMITTED					DATE 1-31-01				
PROJECT_ENGINEER					APPROVED FOR RELEASE LANL_PROJECT_MANAGER				
 Los Alamos National Laboratory PO Box 1663 Los Alamos, New Mexico 87545					SHEET E-6000 10 OF 18				
CLASSIFICATION					REVIEWER		DATE		
PROJECT ID 10692					DRAWING NO C45972			REV 0	

Figure 202-3

- C. Standard LANL Title Blocks have been created on the World Wide Web site listed in Appendix H (<http://www.lanl.gov/f6stds/pubf6stds/drftman/appendix.htm>).

TABLE 202-1
Construction Drawing Title Block Contents

Item	Description	Character/ Size Font	Notes	Data Definition
1	Revision Number	3/32" romans		Number of revision made to the drawing.
2	Date of Revision	3/32" romans		Date the revision was made to the drawings.
3	Classification	3/32" romans	1, 4	The LANL ADC familiar with the project or area of construction will classify the revision and place his/her initials to the right of the classification in the revisions block (Item #3A) with an explanation for the reclassification.
3A	Authorized Derivative Classifier	3/32" romans		
4	Revision Description	3/32" romans		A description of the changes made to the drawing, P.I. number, A/B date, etc.
5	Drawn	3/32" romans	1	Initials and/or last name of the designer/drafter.
6	Design	3/32" romans	1	Initials and/or last name of the designer/engineer.
7	Checked	3/32" romans	1	Initials and/or last name of the checker.
8	Submitted	3/32" romans	3, 5	Initials of the person in the design agency with the authority to release the drawings
9	Approved for Release	3/32" romans	3, 5	Initials of the LANL Project Leader or Facility Manager with final approval for release.
10	Drawing Originating Organization			The logo/name of the organization or firm doing the design.
11	Project Title	3/16" romans	2	A project title will be filled in for: new facility construction, new addition to an existing facility, the installation of a new system in an existing facility, or Standards Manual Drawing. No title descriptions are required, for modifications or upgrades to existing facilities or systems.
12	Project Title Line 2	3/16" romand	2	
13	Sheet Title	1/8" romand	2	A descriptive title of the information contained on the drawing sheet. Typically, the type of drawing (e.g., Process and Instrumentation Diagram)
14	Sheet Title Line 2	1/8" romand	2	Space for continuation of the Sheet Title. Typically, the detail information (e.g., Compressed Air system)
15	Building Number	1/8" romans		The unique identifying number for a building or structure within a designated technical area.
16	Technical Area	1/8" romans		The geographical area designation assigned to LANL properties.

Continued on next page

TABLE 202-1
Construction Drawing Title Block Contents (con't)

Item	Description	Character/ Size Font	Notes	Data Definition
17	Drawn	3/32" romans	1	First initial and last name of the drafter/designer. (Not required for issuance after revision 0.)
18	Design	3/32" romans	1	First initial and last name of the designer/engineer. (Not required for issuance after revision 0.)
19	Checked	3/32" romans	1	First initial and last name of the person who checked the drawings, but not the same person who designed or produced the drawing. (Not required for issuance after revision 0.)
20	Date	3/32" romans	1	Date the final drawing set is issued. Date all sheets the same.
21	Submitted	3/32" romans	3, 5	Typed name and signature of the person at the design agency with the authority to release the documents.
22	Approved for Release	3/32" romans	3, 5	Typed name and signature of the LANL Project Team Leader or Facility Manager responsible for the project with the final approval for release.
23	Responsible Organization	LANL logo		Logo/name of the organization for whom the drawing is produced (LANL).
24	Discipline Sheet Number	1/4" Text height and 0.85 text width romand		Alphanumeric characters sequentially numbered, by discipline through the project drawing set. Also see Section 211.
25	Project Sheet Number	1/4" Text height and 0.85 text width romand		A sequential number assigned to each drawing sheet in a project drawing set.
26	Number of sheets in a project drawing set	1/4" Text height and 0.85 text width romand		Total number of drawings in the project drawing set.

Continued on next page

TABLE 202-1
Construction Drawing Title Block Contents (con't)

Item	Description	Character/ Size Font	Notes	Data Definition
27	Classification	3/32" romans	1, 4	The security classification of the drawing set uses a designation of: “ U ” for Unclassified; “ OUO ” for Official Use Only; “ C ” for Confidential; “ UCNI ” for Unclassified Controlled Nuclear Information; and, “ S ” for Secret. The LANL Authorized Derivative Classifier (ADC) can provide the classification requirements. For a drawing set that contains security information, each drawing shall be stamped with the classification with text of not less than 1/8”. Example: Appendix B symbol G39 UCNI stamp. Locate the stamp to the left of the “Not for Construction/Engineer’s Stamp”
28	Classifier/ Reviewer	3/32" romans	1, 4	The signature or initial and name of the person authorized to classify drawings.
29	Classification Date	3/32" romans	4	Date of classification signature.
30	Project Identification Number	1/4" romand	5	A unique number assigned to a task by the LANL Computerized Maintenance Management System (CMMS). This number is used for projects that generate paper documents and record drawings to be placed with FWO DCRM Team.

Continued on next page

TABLE 202-1
Construction Drawing Title Block Contents (con't)

Item	Description	Character/ Size Font	Notes	Data Definition
31	Drawing Number “C”	1/4” romand	#6	A unique number assigned to the drawing set by the FWO-IBS DCRM Team. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letter “C.” Used for record drawings associated with new facility and additions to existing facility construction.
	Drawing Number “PL”	1/4” romand	#6	A unique number assigned to the plate(s) (PL) set by the FWO DCRM Team. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letters “PL.”
	Drawing Number “SK”	1/4” romand	#6	A unique number assigned to the sketch (SK) by the FWO DCRM Team. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letters “SK.”
	Drawing Number “ST”	1/4” romand	#6	A unique number assigned to the standard drawing (ST) by the FWO DCRM Team. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letters “ST.”
32	Revision Number	1/4” romand		Number of revisions made to the drawing.

Notes:

1. Enter appropriate names and dates electronically. When issuing drawings for design review, initials or signatures are required for the checked, submitted, and classification blocks. For the final issue, initials or signatures are required above or alongside all printed names.
2. Do not underline titles or subtitles.
3. The title block contents 8, 9, 21 & 22 require approvals. The number and headings of approval signatures/initials shall be determined by the LANL Project Leader.
4.
 - a. This section of the title block must be filled in when the record document package is signed off for approval.
 - b. Follow LANL’s S-7 Group requirements for review/signature.
 - c. *Guidance: Use an Authorized Derivative Classifier (ADC) associated and/or familiar with the project. The ADC should be contacted and informed about the project during the early stages of design development.*

- d. ADC in classification shall appear in title block on all technical design review drawing package submittals.²
- e. Drawings placed on MOADS (database) by FWO-IBS DCRM must be unclassified.
5. The following is a guide to assist the design agency to determine P.I.# and C# requirements:
6. See Attachment 1 for Contact Information.

Project Configuration		
	Type of Design Work	Package Requirements
New Project <i>(not Design Build)</i>	a) single TA and single Bldg.	1 (one) PI# and 1 C#
	b) single TA and multiple Bldgs. Note: Use <u>one</u> Title Sheet and separate facilities into individual facility sets within the drawing package.	1 PI#-and separate C#'s for each facility.
	c) multiple TAs and multiple Bldgs. Note: Organize final submittal as follows: Lowest TA# first with individual facility subsets in numerical order, followed by next TA# and facility sequence.	1 PI# and separate C#'s for each facility.
	d) LANL-Wide Project (i.e., road or utility projects)	1 PI# and 1 C#.
New Project <i>(Design Build)</i>	a) single TA and single Bldg. submitted in separate design phase packages. Note: When project is submitted to FWO-DCRM Records Center, consolidate a list of drawings on the first (1st) Title Sheet, void all other title sheets and renumber the drawing sheets sequentially, reflecting the modification in each title block (items #25 & #26) and the 1st Title Sheet.	1 PI# and 1 C# with each design phase package labeled 1, 2, 3, 4, etc.

² Basis: DOE Order 475.1-1, Identifying Classified Information, which is part of the WSS, states in Chapter VI that:

“Review Requirements.” Anyone who originates a document or material in a subject area that may be classified shall submit the document or material to the appropriate official for a classification review and determination prior to dissemination.

a.) Routine Document or Material. An employee with an active access authorization who originates a document or material in a subject area that may be classified shall submit the document or material to a Derivative Classifier for classification review prior to dissemination. An employee who had an active access authorization in the past shall submit such a document or material to the local Classification Officer for classification review prior to dissemination. The local Classification Officer may delegate this review responsibility to specified Derivative Classifiers.”

	Type of Design Work	Package Requirements
Existing Facility (existing system modification)	<p>a) Locate all existing drawings pertinent to the project and follow the drawing revision procedure per Section 103 of this manual as well as AP-ENG-002 and/or AP-ENG-003.</p> <p>b) If new drawing sheets are to be generated, follow this manual for new drawing requirements.</p> <p>c) New sheets generated to accompany a drawing package primarily composed of existing drawings that have been revised:</p> <p>d) New drawings generated for a drawing package comprised of revised drawings from existing multiple packages with several PI# and C#s:</p>	<p>Will have the same PI # as the revised sheets BUT a new C#.</p> <p>The new drawings will have New PI#s and New C#s – with references in the General Notes to the existing drawings.</p>
Existing Facility (New System and/or new addition)	a) Follow 5 a) New Project	

5. Guidance: additional “submittal” or “approved” blocks may be added to suit project sign-off requirements.


3.0 TITLE BLOCK AND DRAWING FORMATS FOR ENGINEERING STUDIES (ES), DESIGN CRITERIA (DC), AND CONCEPTUAL DESIGN REPORTS (CDR)

- A. The drawings produced for Engineering Studies (ES), Design Criteria (DC) and Conceptual Design Reports (CDR) are not intended for use as construction documents; therefore, stamps and signatures are not required. The FWO DCRM Team will enter title block information into its master database when record copy is received.
- B. Provide accurate and consistent information in the title block throughout the drawing set.
- C. Produce Engineering Studies, Design Criteria and Conceptual Design Report drawings on “D” size sheets and submit on 11" X 17" drawing (B size) sheets for binding or folding for insertion into the 8-1/2" X 11" (A size) report format.
- D. Convey the project information in the simple format illustrated below. For a description of the required Title Block Contents see Table 202-2.

- E. These drawings do not have to follow strict LANL Drafting Manual requirements for discipline separation, sheet type separation, or sheet identification format per Section 211. The only requirements are to follow:

Line type, line weights, font size and style, and standard symbols per this manual.

- F. The following is an example of the Title Block format for the Studies and Reports (for a description of contents see Table 202-2).

A/E LOGO HERE			
PROJECT TITLE FIRST LINE			
SECOND LINE			
THIRD LINE			
SHEET TITLE SECOND LINE		C-1010	
BLDG. 362		TA- 44	
		P.O. Box 1663 Los Alamos, New Mexico 87545	
PI 12345	DATE 1-1-2001	PL 1234	


A/E LOGO HERE (11)			
(1)			
(2)			
(3)			
(4)			(5)
BLDG. 362 (6)			(7)
		P.O. Box 1663 Los Alamos, New Mexico 87545	
PI (8)	DATE (9)	PL (10)	

Figure 202-4

TABLE 202-2
Engineering Study, Design Criteria and Conceptual Design Report
Title Block Contents ³

Item	Description	Character/ Size Font	Notes	Data Definition
1	Project Title	1/8" romand	1	A descriptive name of the project. Project Title and Title Sheet required for new facility construction. Not required for modifications to existing facilities.
2	Project Title Line 2	1/8" romand	1	Space for continuation of the Project Title.
3	Project Title Line 3	1/8" romand	1	Space for continuation of the Project Title.
4	Sheet Title	3/32" romand	1	A descriptive title of the information contained on the drawing sheet. There are two lines for the sheet title. First line is generally the type of drawing (e.g., Process and Instrumentation Diagram), second line generally the specific information (e.g., Compressed Air System).
5	Discipline Sheet Number	3/16" romand		Alphanumeric character, sequentially numbered, by discipline through the project drawing set.
6	Building Number	1/16" romans		The unique identifying number for a building or structure within a designated technical area.
7	Technical Area	1/8" romans		The geographical area designation assigned to LANL properties.
8	Project Identification Number	1/8" romans		A unique number assigned to a task by the CMMS.
9	Date	1/8" romans		The date the drawing set is issued for review or as final. Use the same date for all sheets in the drawing set.
10	Plate Number or Sketch Number	1/8" romans		A unique plate number (PL#) / sketch number (SK#) assigned by FWO DCRM Team Office.
11	Drawing Originating Organization	no requirement		The logo/name of the organization or firm doing the design.
12	LANL logo	1/8"		

Note: Do not underline titles or subtitles.

³ Basis: LANL requirement for title blocks.

203 TITLE SHEET

4.0 GENERAL REQUIREMENTS

- A. Provide a Title Sheet for drawings regardless of the number of drawing sheets in the drawing set.
- B. *Guidance: Title sheets are not required but recommended for Engineering Studies, Design Criteria, and Conceptual Design Reports.*

5.0 EXAMPLE OF TITLE SHEET

- A. The following graphic is an example of the Title Sheet for new projects (see Table 203-1 for content description). This Title Sheet (Appendix H) is found on the worldwide web site <http://www.lanl.gov/f6stds/pubf6stds/drftman/appendix.htm>

8	7	6	5	4	3	2	1
H							
G							
F							
E							
D							
C							
B							
A							

PROJECT TITLE ①

BLDG 222 ③ TA-44 ④

②

LOCATION PLAN
SCALE NONE 1:1

PROJECT DESIGN DATA

ANY CODE ANALYSIS INFO THAT HAS
IMPORTANCE TO THE DESIGN PROCESS
SHALL BE DOCUMENTED HERE.
EXAMPLES OF IMPORTANT INFO ARE:
OCCUPANCY CLASSIFICATION
TYPE OF CONSTRUCTION
BUILDING AREA
AREA REPAIRS
FLOOR & ROOF LOADING

⑮

REVISION
NUMBER

⑧

SHEET
NUMBER

⑨

DRAWING
NUMBER

LIST OF DRAWINGS ⑥

⑩

NO.	DESCRIPTION
1	G-0001 TITLE SHEET
2	G-0002 SUBMITTAL SHEET
3	C-0001 SYMBOL, LEGEND AND GENERAL NOTES
4	C-1000 SITE PLAN
5	C-1002 GRADING PLAN
6	C-1003 UTILITIES PLAN
7	C-5000 DETAILS
8	A-0001 SYMBOL, LEGEND AND GENERAL NOTES
9	A-1000 FIRST FLOOR PLAN
10	A-2000 SECOND FLOOR PLAN
11	A-3000 ELEVATIONS
12	A-5010 SECTIONS
13	A-5010 DETAILS
14	A-5010 SCHEDULES: DOOR AND WINDOW
15	A-7010 FINISH SCHEDULES
16	P-0001 SYMBOL, LEGEND AND GENERAL NOTES
17	P-1000 SITE PLAN
18	P-1001 FIRST FLOOR PLAN
19	P-1002 SECOND FLOOR PLAN
20	P-3000 SOMEWHAT: WASTE AND WATER
21	P-8000 SCHEDULES
22	M-0001 SYMBOL, LEGEND AND GENERAL NOTES
23	M-1000 FIRST FLOOR PLAN
24	M-1010 SECOND FLOOR PLAN
25	M-2000 ELEVATIONS
26	M-3000 SECTIONS
27	M-5000 DETAILS
28	M-5000 FINISH AND INSTRUMENTATION DIAGRAM
29	M-5010 SCHEDULES
30	E-0001 SYMBOL, LEGEND AND GENERAL NOTES
31	E-1000 FIRST FLOOR PLAN
32	E-1010 SECOND FLOOR PLAN
33	E-5000 ONE LINE DIAGRAM
34	E-7000 SCHEDULES

PRODUCT OPTIONS/SUBSTITUTIONS

"FOR APPROVED EQUIP." IS ALWAYS IMPLIED AFTER A BRAND NAME, PATENTED
PROCESS OR CATALOG NUMBER. THE CONTRACTOR MAY SUBSTITUTE ANY
BRAND, PROCESS OR CATALOG NUMBER APPROVED AS AN EQUIV. BY THE
CONTRACT ADMINISTRATOR. THE ONLY EXCEPTION IS WHERE "NO
SUBSTITUTION" IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND
WORKMANSHIP".

⑦

⑭

NO.	DATE	CLASS.	REV.	DESCRIPTION	DESIGNED BY	CHECKED BY	DATE
1							

LANL ENGINEERING STANDARDS

PROJECT TITLE
PROJ_TITLE_CONT

SHEET TITLE

BLDG: 222 TA-44

DATE: 1-1-01

DESIGNED BY: [Signature]

CHECKED BY: [Signature]

DATE: 1-1-01

PROJECT NO: 12345 SHEET NO: C12345

80% REVIEW
NOT FOR CONSTRUCTION

Figure 203-1

**TABLE 203-1
Title Sheet Contents**

Item	Description	Character/ Size Font	Data Definition
1	Project Title	1 inch, Romand, double underline 0.50 mm line width, color 1, continuous	The descriptive name of the project. Project title and title sheet required for new facility construction. Not required for modifications to existing facilities.
2	Location Plan	No scale	A plan that illustrates the location of the project - see Figure 203-1.
3	Building Number	1/2 inch, Romand, double underline 0.50 mm line width, color 1, continuous	The unique identifying number for a building or structure within a designated technical area.
4	Technical Area	1/2 inch, Romand, double underline	The geographical area designation assigned to LANL properties.
5	Project Design Data	1/8 inch Romand	This information is required (if not covered in specifications) - usually pertinent code analysis information is inserted here. Reference the code used and date of the code. (See Engineering Standards Manual, Chapter 4 - Architectural, Project Design Data.)
6	List of Drawings	1/4 inch Romand, single underline 0.50 mm line width, color 1, continuous	The header for the Drawing List.
7	Product Options and Substitution Statement	1/8 inch, Romand	A brief LANL procurement policy statement - see subpart 4.0 herein.
8	Sheet Number	1/8 inch Romand	The column header for the list of drawings sheet numbers.
9	Discipline Sheet Number	1/8 inch Romand	The column header for the list of drawings discipline sheet numbers.
10	Drawing Title/Header	1/8 inch Romand	List of the drawing sheet titles - show exactly as they appear in the title blocks of the drawing sheets.
11	Sheet Number	1/8 inch Romans	The number shown in the title block of each drawing sheet.
12	Discipline Sheet Number	1/8 inch Romans	The number shown in the title block of each discipline drawing sheet.
13	Drawing Titles	1/8 inch Romans	List of drawing sheet titles - show exactly as they appear in the title blocks of the drawing sheets.
14	Title Block	-	See Section 202.
15	Revision Column	1/8 inch Romand	The column header for the list of revisions that affect the drawing sheets.
16	Date Stamp	3/32" Romans	This stamp will assist in drawing file management, locating projects and data.
17	Reference Drawings	3/16 Romand	See definition in section 101.D

Note: All entries on the title sheet will be on layer: text, color: white, 0.35 mm pen width (0.015").

6.0 LOCATION PLAN

A Location Plan is an area map that graphically illustrates the general location, by technical area, where the construction is planned.

- A. All drawing sets are required to have a Location Plan.
- B. Locate this plan on the Title Sheet in the upper right hand corner of the sheet (Fig. 203-1), as illustrated in Figure 203-2. The plan and all text shall not cover more than a 7.5" x 7.5" square.
- C. Show enough of the surrounding areas (streets, buildings, structures, etc.) to clearly identify the project location.
- D. Orient the Location Plan on the drawing sheet so that the north arrow points to the top of the sheet, as illustrated below.
- E. An electronic or hard copy Location Plan can be obtained from the FWO-DCRM Team or the Support Services Subcontractor UMAP program for various Technical Areas within the LANL boundary.

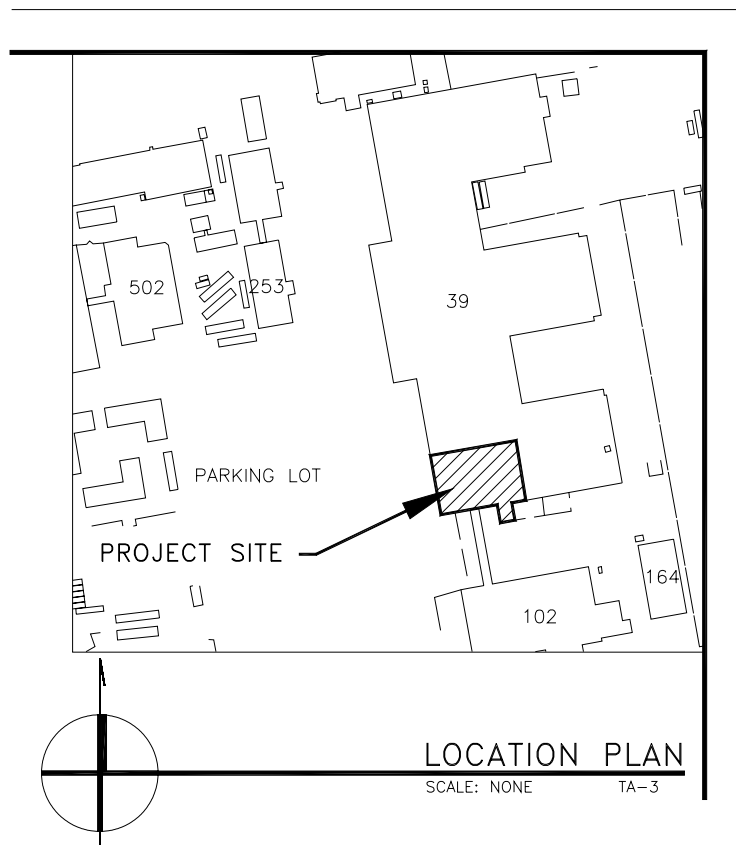


Figure 203-2

F. The borderline around the location plan shall be 0.50 mm line width.

G. Text requirements:

Project Site	3/16 inch romand
Location Plan	1/4 inch romand
TA	1/8 inch romans
All on Color: 7	Layer: G-ANNO

7.0 PRODUCT OPTIONS AND SUBSTITUTIONS

Note: This block is used only if a specific manufacturer's product is listed in the drawing package.

1. Enter the substitution statement exactly as stated in Section 01630 of the LANL Construction Specifications, layer: text.
2. The following is the wording from Section 01630 as of July 2001:

PRODUCT OPTIONS AND SUBSTITUTIONS

(3/16" text height, romand)

"Or approved equal" is always implied after a brand name, patented process or catalog number. The contractor may substitute any brand or process approved as an equal by specifying Architect/Engineer.

The only exception is where "no substitution" is specified.

See General Provision "Material and Workmanship."

(1/8" text height, romans)

3. For location of this block see Section 203, subpart 2.0, Example of Title Sheet.
4. Per LANL Construction Specifications Manual, Section 202.4, "Do not put specifications on drawings".

204 PLAN ORIENTATION

1.0 GENERAL

- A. Except for Civil Plan and Section (profile) drawings, comply with the following for plan orientation on drawing sheets. *Guidance: Whenever possible orient the site plan in the same manner as the floor plan.*
1. Place the principal plans on the drawing sheet with the building lines parallel to the sheet borders.
 2. Orient all principal plans in the drawing set identically for continuity and clarity.

- [illegible]

Page 23 of 56

2.0 GENERAL REQUIREMENTS FOR NORTH ARROW

- A. Placement of the North Arrow symbol is at the left end of the horizontal line under the title.
- B. For “C,” “D,” and “E” size sheets make the circle 5/8 inches in diameter. For “A” and “B” size sheets make the circle 5/16 inches.

*Figure 205-2***206 PARTIAL PLANS****1.0 KEY PLANS**

- A. Use a small scale "key plan" for each drawing sheet on which a partial plan appears.
- B. Clearly indicate on the "key plan" where the partial plan occurs in the overall building layout.
- C. Orient partial plans and key plans identically.
- D. Locate the “key plan” in the upper right hand corner of the sheet and occupy a space no larger than a 5” x 5” square including all text.
- E. Enlarged plans are considered partial plans if the enlarge plan only depicts a portion of the completed floor plan.

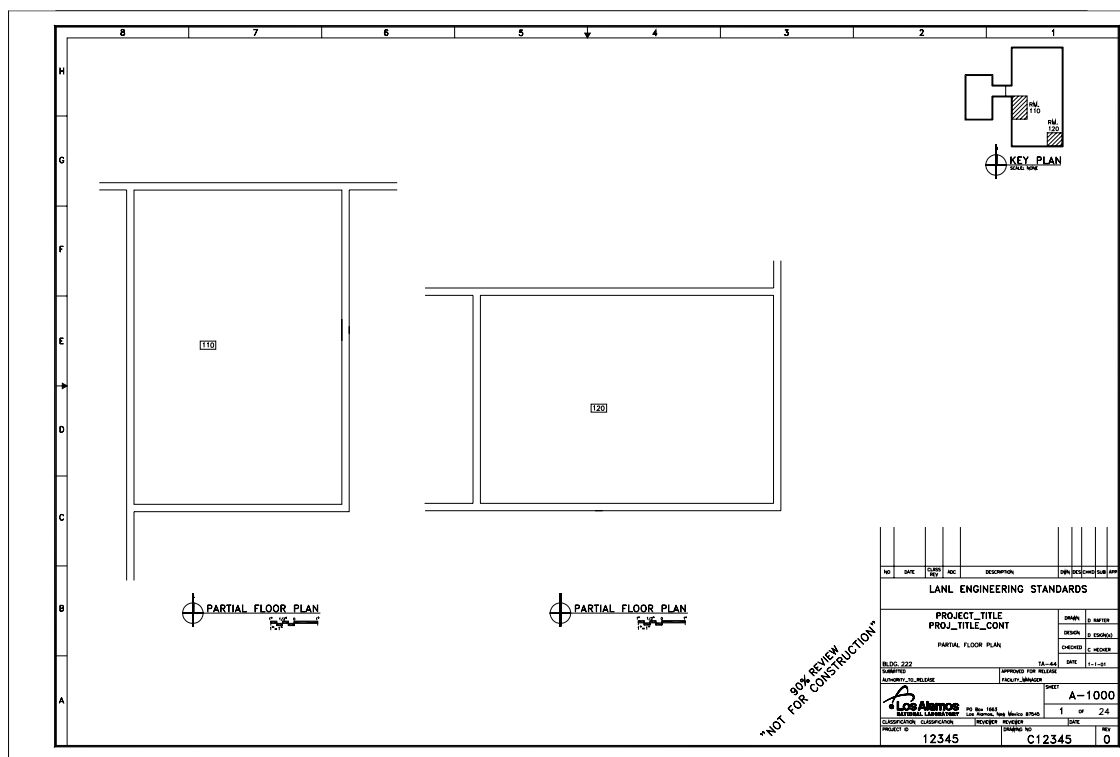


Figure 206-1

2.0 MATCH LINES

- When a plan is too large for one drawing sheet, divide the plan into logical sections.
- Provide a match line that is 0.80 mm (0.031") thick, center line type.
- Use a 1/4" text height, romand font, 0.50 mm line width to clearly indicate where the plan continues on another sheet, as illustrated below.
- Use a key plan (see Figure 206-1 above).

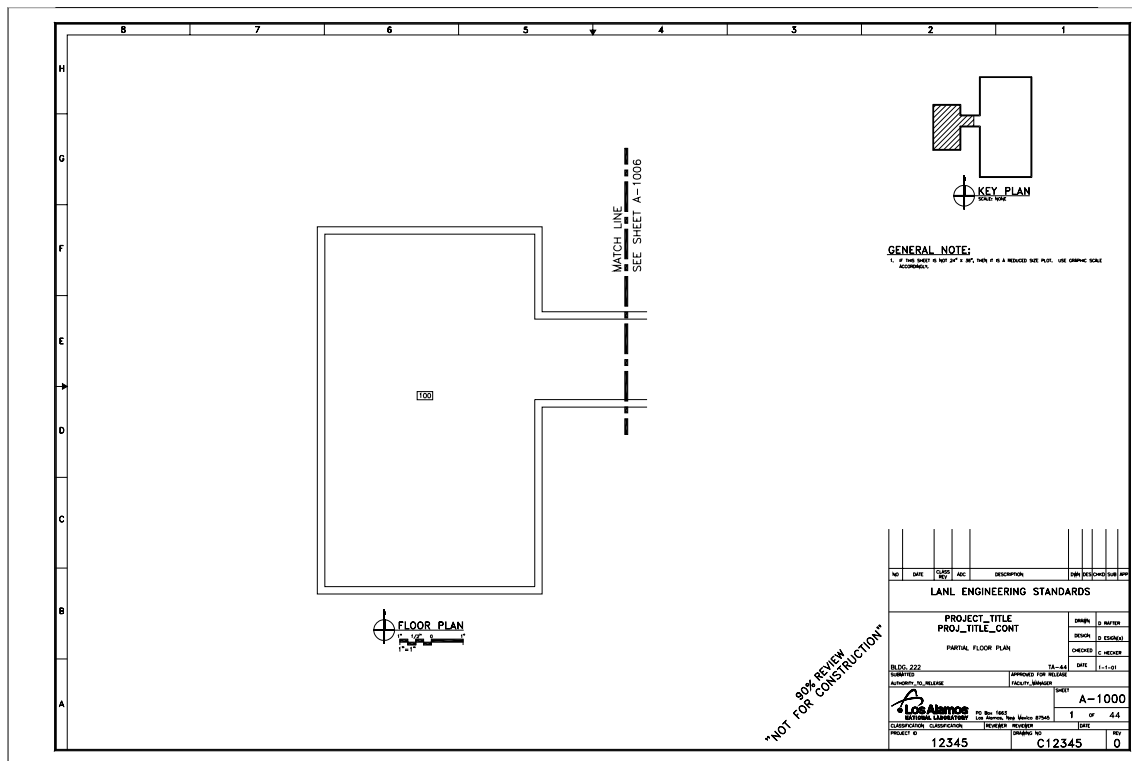


Figure 206-2

207 SUBMITTAL SHEET

1.0 CRITERIA AND GUIDELINES FOR SUBMITTAL SHEET

It is strongly recommended that LANL Construction Specifications section [01330](#), Submittal Procedures, be used. In all contract packages alternatively include a submittal sheet (General Information “G” Sheet) in the drawing set when submittals are required but when a specification package is not included with the construction documents. Use the following guidelines in producing the submittal sheet and stating the submittal requirements:

- A. Produce a Submittal Schedule and Definition of Submittal Types on the “G” sheet (See Figure 207-1).
- B. Do not place submittal lists on any of the discipline sheets.

2.0 NUMBERING THE REQUIRED SUBMITTALS

- A. Assign each submittal an alphanumeric designation using no more than 3 characters. This alphanumeric designation is the “SUB NO.” in the submittal schedule illustrated on the following page.

- B. An alphanumeric designation represents the discipline requiring the submittal. Assign an alpha character representing the discipline using Section 210, Drawing Set Organization, as a guideline.
- C. Assign a sequential number designation to the submittal by discipline.

3.0 SUBMITTAL SCHEDULE

The schedule is a General Symbols block (G44), found in [Appendix B](#) of this manual and LANL Construction Specifications, Section [01330](#).

Example of Submittal Sheet

[illegible]

DEFINITIONS OF SUBMITTAL TYPES

CA. CALCULATIONS

THE METHODS AND RESULTS OF CALCULATIONS IN DOCUMENTED FORM WHERE SPECIFIED.

CD. CATALOG DATA

STANDARD PRINTED INFORMATION ON MATERIALS, PRODUCTS, AND SYSTEMS, WHICH SHOWS PERFORMANCE CHARACTERISTICS, DIMENSIONS, MATERIAL OF FABRICATION, AND OTHER CHARACTERISTICS NECESSARY TO ASSURE CONFORMITY WITH THE DESIGN REQUIREMENTS. WHERE OTHER ITEMS OR INFORMATION NOT RELATED TO THE WORK OF THIS PROJECT ARE INCLUDED IN THE LITERATURE SUBMITTED, THE ITEM(S) AND/OR INFORMATION APPLICABLE TO THIS PROJECT SHALL BE CLEARLY MARKED.

CT. CERTIFICATIONS

A WRITTEN STATEMENT, SIGNED BY A QUALIFIED PARTY, ATTESTING THAT ITEMS OR SERVICES ARE IN ACCORDANCE WITH SPECIFIED REQUIREMENTS. TYPICALLY, THIS WRITTEN STATEMENT IS ACCOMPANIED BY ADDITIONAL INFORMATION TO SUBSTANTIATE THE STATEMENT.

II. INSTALLATION INSTRUCTIONS

MANUFACTURER'S INSTRUCTIONS, STEP-BY-STEP IF NECESSARY, SHOWING THE FIELD INSTALLATION OF PARTS, COMPONENTS, EQUIPMENT AND OTHER SIMILAR ITEMS.

ML. MATERIAL LIST/PARTS LIST/DESIGN MIXES

A LIST OF SYSTEM COMPONENTS OR MATERIAL COMPONENTS.

PD. PERFORMANCE CURVES/DATA

PERFORMANCE CURVES AND/OR DATA FOR THE SELECTED EQUIPMENT TO SHOW COMPLIANCE WITH CONTRACT DOCUMENTS.

SC. SAMPLES/COLORS

SAMPLES, INCLUDING COLORS OF PROPOSED MATERIALS.

SD. SHOP DRAWINGS

DRAWINGS NECESSARY TO SHOW FABRICATION DETAILS TO ENSURE COMPLIANCE WITH CONTRACT DOCUMENTS.

TR. TEST REPORTS

RESULTS OF SPECIFIED TEST REQUIREMENTS.

WD. WIRING DIAGRAMS

DRAWINGS SHOWING THE POINT-TO-POINT WIRING OF A PIECE OF EQUIPMENT OR BETWEEN PIECES OF EQUIPMENT IN A SYSTEM.

OM, SP. O&M MANUALS/SPARE PARTS LIST/WARRANTIES

MAINTENANCE SUBMITALS SHALL INCLUDE BOTH MAINTENANCE AND OPERATING MANUALS. INCLUDE EMERGENCY INSTRUCTIONS, SPARE PARTS LISTINGS, WARRANTIES, WIRING DIAGRAMS, RECOMMENDED "TURN-AROUND" CYCLES, INSPECTION PROCEDURES, SHOP DRAWINGS, PRODUCT DATA, AND SIMILAR INFORMATION AS APPLICABLE.

RD. PROJECT RECORD DOCUMENTS

AS-BUILT DRAWINGS: A SET OF RED LINED PRINTS NOTING ALL DEVIATIONS FROM THE CONSTRUCTION DRAWINGS.

Figure 207-1

208 DRAWING SCALES AND TOLERANCES

1.0 GRAPHIC SCALES

- A. When drawings are produced to scale, insert graphic scales illustrating the drawing scale. Use these formats for standard graphic scales: (Refer to [Appendix B](#))

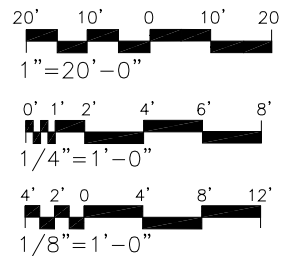


Figure 208-1

- B. In the illustration above, 3/32" text (the minimum allowable) is shown for the distance designations for all graphic scales because of the limited space available. The drawing scale designation text is shown at 1/8". These text heights were selected for graphic clarity. Graphic scales are to be right justified⁵ and 1/4" below the drawing title, see Figure 206-1 and 206-2 for examples.
- C. Include the following statement as a General Note on the drawing sheet:
 "If this sheet is not (state the original plot size, i.e., 24" x 36"), then it is a reduced size plot. Use graphic scale accordingly."

2.0 DRAWING SCALES

- A. Acceptable drawing scales and the call out protocol for drawings are as follows:

<u>Item</u>	<u>Scale</u>	<u>Item</u>	<u>Scale</u>
Contour,	1" = 10'	Plan & Profiles:	
Grading,	1" = 20'	Horizontal Scale:	1" = 10'; 1" = 20'
Landscaping,	1" = 30'	Vertical Scale:	1" = 5'; 1" = 10'
Site,	1" = 40'		
Utility,	1" = 50'	Sections:	1/8" = 1'-0"
Plans:	1" = 60' *		1/4" = 1'-0"
	1" = 100'		1/2" = 1'-0"
	1" = 200'		3/4" = 1'-0"
	1" = 500'		1" = 1'-0"
	1" = 1000'		

* **Note:** New Mexico plot size (LANL design basis)

(Continued on next page)

⁵ Per National CAD Standards

<u>Item</u>	<u>Scale</u>	<u>Item</u>	<u>Scale</u>
Floor Plans and Elevations:	1/16" = 1'-0"	Partial/Enlarged Plans:	1/4" = 1'-0"
	1/8" = 1'-0"		1/2" = 1'-0"
	1/4" = 1'-0"		3/4" = 1'-0"
Details:	1/2" = 1'-0"		
	3/4" = 1'-0"		
	1" = 1'-0"		
	1 1/2" = 1'-0"		
	3" = 1'-0"		

Basis: National CAD Standards

- B. If a graphic scale is used then the use of "SCALE": x" = x'-0" is not required under title. If "SCALE: NONE" is used under title, then the graphic scale is not required.

3.0 CONSISTENCY OF DRAWING SCALES

Draw all principal plans in a drawing set at the same scale, line type and line width.

4.0 EQUIPMENT ROOM DRAWING SCALES

- A. Layout all equipment, piping, conduits, trays, ducts, wiring, etc., located within the equipment rooms on an enlarged partial floor plan shown at 1/4" = 1' - 0" scale minimum.
- B. In rooms, areas, and spaces that are designed to accommodate equipment, show the equipment layout in detail plans, interior elevations and sections, as required for clarity.
- C. Use enlarged sections and details to show congested areas at minimum scale of 1/2" = 1' - 0" for clarity.

5.0 NO SCALE DRAWINGS

Certain details, diagrams, and plans cannot or need not be drawn to a specific scale (i.e., wiring, P&IDs, schematics, and control diagrams). For the drawing scale notation type "SCALE: NONE" indicating that no scale was used in generating the drawing.



Figure 208-2

6.0 TOLERANCES

Guidance: Tolerances should be noted per ANSI Y14.5 - 1994, "Dimensioning and Tolerancing for Engineering Drawings (inches)," and client design criteria.

209 DIMENSIONING & LEADERS

1.0 GENERAL

- A. Specify dimensions of less than one foot in inches, for example:

11 1/2"

- B. Specify dimensions one foot and over in feet and inches, for example:

2' - 6 1/4"

- C. Exception to these rules occurs when dimensioning civil drawings, mechanical ductwork and piping, electrical control cabinets and boxes, or architectural woodwork.
- D. Do not stack fractions.

2.0 DIMENSION LINE CONVENTION AND TEXT ORIENTATION

- A. Use unbroken dimension lines with the dimension text located above the line. All dimension text must be read from the bottom or right side of the drawing sheet.

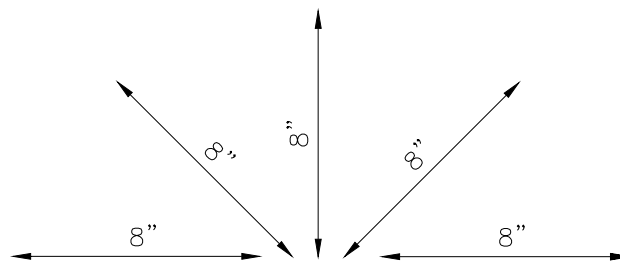


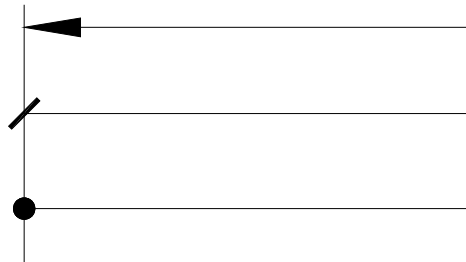
Figure 209-1

- B. *Guidance: For examples of text orientation for isometric drawings refer to Global Engineering Documents, current edition, Section 3 and 4; DOE Handbook 1016, or AIA Architectural Graphic Standards.*

3.0 DIMENSION LINE TERMINATION

- A. Arrowheads, slashes, and dots are all acceptable terminators for dimension lines.

- B. Draw a heavy terminator (arrowhead 1/8" in length, 45 degrees diagonal, 0.80 mm line width tic mark, or 1/16" diameter solid circle) to ensure readability when reproduced or reduced to half size. Use a consistent terminator throughout all drawing sheets for a discipline in a drawing set. AutoCAD setting for terminator to be 1/8 inch. Text shall be 1/8" romans, color-white. Arrows and dimension line shall be color 9.

*Figure 209-2*

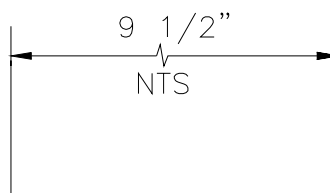
- C. "Tic" marks shall be used in the architectural discipline.
- D. Do not mix termination symbols within a discipline.

4.0 PLAN DIMENSIONS

- A. *Keep dimension lines clear of the building footprint whenever possible.*
- B. *Place dimension lines in a logical progression (i.e., centerlines, projections, overall, etc.).*
- C. *Keep the dimensions consistent on all plans.*
- D. *Tie all building portions together clearly.*
- E. *Do not dimension to hidden features.*
- F. *Refer to the National CAD Standards Manual Drafting Conventions, current edition, for hierarchy of dimensioning.*

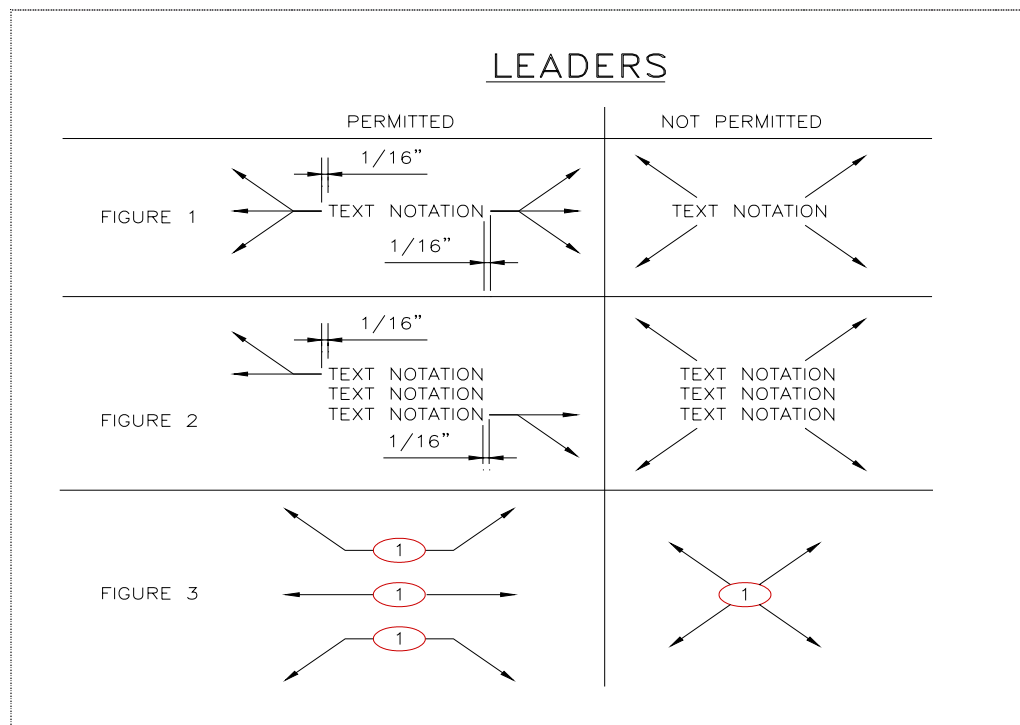
5.0 DIMENSIONS NOT TO SCALE

- A. When dimensional changes are made on drawings that affect the dimensions shown on a detail, it is not necessary to change the detail to agree with the new dimension. Change the dimension text to match the new dimension and note "NTS" below the dimension line, to indicate "Not to Scale" as illustrated below.

*Figure 209-3*

6.0 LEADERS

- A. All leaders with single text notations shall start from the leader terminator (arrow) and end 1/16" from the text notation. See Figure 1.
- B. All leaders with multiple text notations shall start from the leader terminator (arrow) and end 1/16" from the text notation. Hence: upper left corner or lower right corner of the note. See Figure 2.
- C. Leaders for use with Keyed Notes shall start from the leader terminator (arrow) and end/attach at the edge of the Keyed Note Bubble. See Figure 3.
- D. Crossing of leaders is not allowed.
- E. Leader terminator is a 1/8" arrow when plotted 1:1 on a "D" size drawing.
- F. Use a 1/8" dot for a leader terminator to indicate a surface point on a "D" size drawing when plotted 1:1.



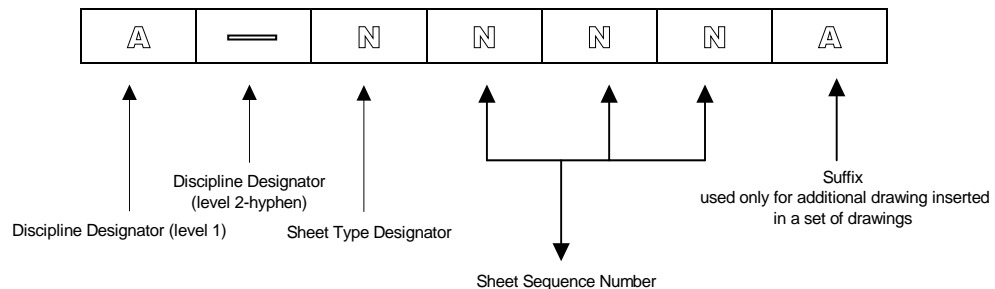
Arrow length = 1/8"
Arrow color = Lt. Gray (9)

Figure 209-4

210 DRAWING SET ORGANIZATION

1.0 STANDARD SHEET IDENTIFICATION (NUMBERING)

- A. The required sheet identification format is applicable to all construction drawing production (Title I and Title II) (This does not include ES or CDRs). It is consistent, yet flexible enough for a wide range of project scopes. The Uniform Drawing System (UDS) by the Construction Specifications Institute (CSI) sheet identification format depicted here has three components:



LEVEL 1: Discipline designator, consisting of 1 alphabetical character,

A	==	N	N	N	N	A
---	----	---	---	---	---	---

LEVEL 2: Discipline designator, is not used, replace with a hyphen,

A	—	N	N	N	N	A
---	---	---	---	---	---	---

- B. The **Sheet Type Designator**, identifies the type of information on the sheet and is followed by the **Sheet Sequence number**. **Sheet Type designator**, consisting of 1 numerical character,

A	==	N	N	N	N	A
---	----	---	---	---	---	---

Sheet Sequence number, consisting of 3 numerical characters.

A	==	N	N	N	N	A
---	----	---	---	---	---	---

Supplemental Drawing Sheet

A	==	N	N	N	N	A
---	----	---	---	---	---	---

- C. The one-character **Discipline designator** identifies the sheet as a member of a subset.
1. Within the discipline designator, the first character is the discipline character. The discipline character identifies the creator of the drawings on the sheet.

2.0 LEVEL 1 - DISCIPLINE DESIGNATOR

- A. The first component of the sheet identification format, the discipline designator, is based on the traditional system of alphabetical discipline designators.
- B. Organize the drawing sets by discipline in the following order (as applicable):

Order Sequence	Discipline Code	Discipline
1	G	General (Title Sheet, General Notes, Scope of Work, Submittals)
2	H	¹ Hazardous Materials
3	V	Survey/Mapping
4	B	Geotechnical
5	W	¹ Civil Works (User Defined)
6	C	Civil
7	L	¹ Landscape
8	S	Structural
9	A	Architectural
10	I	Interiors
11	Q	Equipment (laboratory, food service parking lot, site)
12	F	Fire Protection
13	P	Plumbing
14	D	² Process (e.g., gloveboxes and process piping to and from gloveboxes), fumehoods and process equipment
15	M	Mechanical
16	E	Electrical
17	T	Telecommunications
18	R	¹ Resources
19	X	Other Disciplines (i.e., Safeguards & Security)
20	Z	¹ Contractor/Shop Drawings
21	O	Operations

¹ Uniform Drawing System (UDS) discipline code not used at LANL.

² UDS discipline code modified for LANL application.

3.0 SHEET TYPE DESIGNATOR

- A. The second component of the sheet identification format is the sheet type designator. The sheet type is identified by a single numerical character. All sheet types may not apply to all discipline designators. It is not necessary to use all the sheet types for a project or within a discipline.
- B. Organize the Sheet Types in the following order (as applicable):

TABLE 210-1

0	General (symbols legend, notes, etc.)
1	Plans (horizontal views including civil plans & profiles)
2	Elevations (vertical views)
3	Sections (sectional views)
4	Large Scale views (plans, elevations, or sections that are not details)
5	Details
6	Diagrams
7	Schedules
8	User Defined (for types which do not fall in other categories)
9	3D Representations (isometrics, perspectives, models, and photographs)

4.0 SHEET SEQUENCE NUMBER

- A. The third component of the sheet identification format is a three-digit sheet sequence number that identifies each sheet in a series of the same discipline and sheet type. The first sheet of each series is number **000**, followed by **001** through **999**. (A three (3) - digit sequence number is required for efficient electronic file sorting and facility management databases.)

A	—	N	N	N	N	A
---	---	---	---	---	---	---

- B. On plan sheets, it may be desirable to replicate the floor name within each discipline. This makes sheets **A-1002**, **M-1002**, and **E-1002** the second floor plan for each of the various disciplines. This system may become cumbersome when basements and mezzanines or split level plans are involved. Evaluate each project carefully before deciding to implement this option.
- C. Additional drawings inserted in a set of drawings after a sheet identification organization has already been established can be identified with a suffix. *This suffix may be comprised of a defined designator; starting with the letter "A."*

211 ARRANGEMENT AND NUMBERING SEQUENCE

1.0 DRAWING SETS

- A. Shall be arranged in a defined order and assigned a unique number, within each discipline, as specified in Table 211-1. These sheet sequence numbers must be unique not only within the drawing set, but also unique with respect to ALL other drawings for each structure. For example, if an E-6000 already exists for a particular structure, then the next drawing set created must either revise this pre-existing E-6000 or begin its sheet sequence at E-6001. A list showing what drawings already exist and which sheet sequence numbers have already been used can be obtained from FWO-IBS DCRM team (667-4696) or search "Facility Custom Reports" on-line at http://arania.lanl.gov/fwo_pub/fwo_iim/data/html/moads.html. (Crypto authentication required).

Note: Drawing sets will not always include all of the types of drawings listed below, and show the commonly used disciplines:

TABLE 211-1

Discipline	Numbering Sequence	Order of Drawings
(G) General	0001 - 0999	General (Title Sheet, Legend, General Notes; Scope of Work, Construction Sequence, Project Specifications (3), and Orientation Maps)
(V) Survey / Mapping	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans, (Demolition dwgs first, followed by New Construction), Boundary, Contour, Archaeological, and historical features
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

Discipline	Numbering Sequence	Order of Drawings
(B) Geotechnical	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans Demolition dwgs first, followed by New Construction
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(C) Civil	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction, Site, Grading, Utility, Soil Boring logs, Plan & Profile,)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections/Cross Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(S) Structural	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

Discipline	Numbering Sequence	Order of Drawings
(A) Architectural	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1049	Reserved for Record Floor Plans
	1050 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(I) Interiors	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(Q) Equipment	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

Discipline	Numbering Sequence	Order of Drawings
(F) Fire Protection	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules,
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(P) Plumbing ¹	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules and Lists
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(D) Process	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams (Process Flow, Piping & Instrumentation for process systems, gloveboxes and fume hoods)
	7000 - 7999	Schedules, Lists
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs, risers)

Discipline	Numbering Sequence	Order of Drawings
(M) Mechanical ²	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Submittals, Scope of Work Construction Sequence, Schedules)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams (PFDs, P&IDs, Logic)
	7000 - 7999	Schedules, Lists
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(E) Electrical	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction) (floor, equipment, power, lighting, grounding, lightning, emergency, special systems)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams (one-lines, ladder grounding lightning wiring, logic, schematics (control systems i.e.: PLC cabinet), Riser - Fire Alarm Public Address Communication Security.
	7000 - 7999	Schedules (Bill of Material, Nameplate, etc.)
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(T) Tele-communication	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

Discipline	Numbering Sequence	Order of Drawings
(O) Operations	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence [for construction by Support Services Subcontractor only], Schedules/Lists)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
(R) Other Disciplines (i.e., Security & Safeguards)	0001 - 0999	General (Design Criteria Information, Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition dwgs first, followed by New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

¹. Drainage (for plumbing systems see Section 307 of this manual).

². Air conditioning, ventilation, cooling, heating, refrigeration, fuel oil, compressed air, laboratory gas steam and condensate systems.

³. Refer to ESM Chapter 1, Section Z10 for specification requirements.

2.0 PRIORITY DRAWINGS

A. *Guidance: Priority Drawings typically consist of piping and instrument diagrams (P&IDs), flow diagrams, and electrical one-line diagrams helpful to the safe operation and shutdown of a facility. Other types of drawings such as architectural drawings, mechanical prints, floor plans, piping schedules, or databases may be included if facility requirements dictate.*

- B. The importance of the system and its documents (e.g., drawings) shall be determined by the Facility Manager for new and existing facilities in regards to control of nuclear and non-nuclear hazards, the safety of the public, environment, worker (i.e., hazard class, hazard category, etc.), and the facility mission ([LIR240-01-01](#), Configuration Management).
- C. A priority drawing shall have the words “PRIORITY DRAWING” stamped in black or electronically inserted on the sheet, 1/4” text height, layer “PRIORITY,” color white, Romand font. The words shall appear just above the title block space allocated for revisions. Refer to the ESM Chapter 6, Mechanical [P&ID](#) example drawings.
- D. For revising priority drawings follow LANL AP-ENG-002, *Developing and Revising a Design Change Package* or AP-ENG-003, *Developing and Revising an Engineering Change Notice* for appropriate application.

212 LINE WORK

1.0 BASIC LINE WIDTHS, AND SCREENING

- A. Requirement:
 - 1. Use a heavy line width to indicate new construction for a given discipline.
 - 2. Use a medium line width for text and to delineate new construction above or below the drawing plane.
 - 3. Use a light line width to delineate existing construction or new background base plans, and for dimension lines, leader lines and extension lines.

B. Contrast the three line widths definitively as illustrated below:

LINE DESCRIPTION	LINE APPEARANCE	LINE TYPE	LINE WIDTH
CENTER LINE		CENTER	0.25 MM 0.010 INCH
DIMENSION LINE		CONTINUOUS	0.25 MM 0.010 INCH
LEADER LINE		CONTINUOUS	0.25 MM 0.010 INCH
FUTURE CONSTRUCTION		DASHED	0.25 MM 0.010 INCH
EXISTING CONSTRUCTION		PHANTOM	0.25 MM 0.010 INCH
HIDDEN LINE		HIDDEN	0.35 MM 0.015 INCH
NEW CONSTRUCTION AND REVISION CLOUD		CONTINUOUS	0.50 MM 0.020 INCH
NEW CONST. BACKGROUND (ARCHITECTURAL)		CONTINUOUS	0.25 MM 0.010 INCH
NEW CONST. BACKGROUND (ALL OTHER DISCIPLINES)		PHANTOM	0.25 MM 0.010 INCH
MATCH LINE		CENTER	0.80 MM 0.031 INCH
EXISTING TO BE REMOVED		PHANTOM	0.25 MM 0.010 INCH LINE 0.50 MM 0.020 INCH ASTERISK
P&ID PROCESS LINES, SECTION CUTS, HIGHLIGHT BOX AROUND TEXT		CONTINUOUS	0.80 MM 0.031 INCH
BREAK LINE		CONTINUOUS	0.35 MM 0.015 INCH
HATCH LINES	VARIES	VARIES	0.25 MM 0.010 INCH LINE

NOTE: MAKE SURE THAT THE LINE TYPE SCALE IS SET PROPERLY FOR THE DRAWING SCALE.
(SEE APPENDIX A FOR SETTING FACTORS)

ALLOWABLE SCREEN TYPES	15%	PLOT DENSITY AND SET COLOR TO 222
FOR CIVIL, STRUCT., AND	25%	PLOT DENSITY AND SET COLOR TO 232
ARCH. DISCIPLINES ONLY	35%	PLOT DENSITY AND SET COLOR TO 242

Figure 212-1

Note: Make sure that the LT scale is set properly for the drawing scale. (See Appendix A for setting factors.) Screening 15, 25, and 35%.

2.0 LINE WIDTH ASSIGNMENT IN ELECTRONIC FILES

A. Assign lines a width by creating the line or entity in an appropriate layer. Each layer is assigned a color for the desired line width of entities created in that layer. As indicated in the table below, colors 1 through 15 are the extent of the allowable color range for LANL projects.

	Color Number	Line Width in mm	Line Width in Inches
Red	1	0.50	0.020
Yellow	2	0.50	0.020
Green	3	0.50	0.020
Cyan	4	0.50	0.020
Dark Blue	5	0.35	0.015
Magenta	6	0.35	0.015
White	7	0.35	0.015

	Color Number	Line Width in mm	Line Width in Inches
Dark Gray	8	0.35	0.015
Light Gray	9	0.25	0.010
Red	10	0.25	0.010
Mauve	11	0.25	0.010
Dark Red/Brown	12	0.25	0.010
Light Red/Brown	13	0.80	0.024
12	14	0.80	0.031
Brown	15	0.50	0.010

Note: Some LANL groups and projects may require or prefer color reproductions; the color yellow is not legible and should not be used in these cases.

213 STANDARDIZATION OF TEXT

1.0 FONT STYLES AND TEXT SIZE REQUIREMENTS

- A. Use only standard AutoCAD fonts: Romans and Romand. Do not use stylized fonts or fonts not standard to AutoCAD.
- B. Fonts other than Romans and Romand can be used on the title sheet (Section 203) for the Design Agency logos. If a logo contains a font that is not standard to AutoCAD, convert the logo to a drawing or change the logo to an electronic format that can be read by the standard AutoCAD package.
- C. Match the existing font style and height for uniformity of presentation when revising existing drawings.
- D. The minimum text height in the drawing field on C and D size sheets is 1/8 inch.
- E. The minimum text height in the drawing field on A and B size sheets is 3/32 inch.
- F. The minimum text height only applies in circumstances when another convention is not specified in this document.

2.0 TEXT FORMATTING CONVENTIONS

- A. Create all text in upper case letters, with the exception of certain unit designations such as kVA, mm, kHz, Vac, Vdc, mA, which are recognized as an industry standard.
- B. Use text that is legible when reduced to one-half size on half-size drawing sets.

- B. Font width for sheet numbers in detail, elevation, and section bubbles shall be 0.75.
- C. Do not duplicate letter or numbers on either the Sections or Detail sheets.
- D. Start lettering or numbering sequence at the Upper Left Corner and finish at the Lower Right Corner of drawing.
- E. Do not explode blocks generated for sections, elevations, and/or details.

2.0 REFERENCE DESIGNATIONS

- A. Identify sections and elevations by **LETTERS**, and details by **NUMBERS**. Reference sections, elevations and details with the discipline sheet number, for example: A1000, C-1000, S-1000, ...

3.0 PROTOCOL FOR REFERENCES AND CALLOUTS

- A. On the sheet where details, sections or elevations are drawn, number or letter them independently by sheet, as opposed to consecutively by discipline or project. Order the numbers and letters sequentially in each drawing sheet that contains elevations, details or sections. Begin with the number 1 for details, and the letter "A" for the elevation or section designation. Start at the upper left corner of the sheet and finish at the lower right corner, working from left to right-like reading a page in a book.
- B. When a detail or section is eliminated, the deleted detail or section number or letter may be reused or left blank. The details or sections do not have to be renumbered as the result of a deletion.

4.0 EXAMPLES OF PROTOCOLS

- A. A section, detail or elevation drawn on the same sheet with a plan or collectively is not permitted. (Exception: see Section 100, 3,0D-Definitions and 4.0-Sketches)

B. A detail, section or elevation **not** drawn on the sheet it is referenced or cut (see figure 214-1):

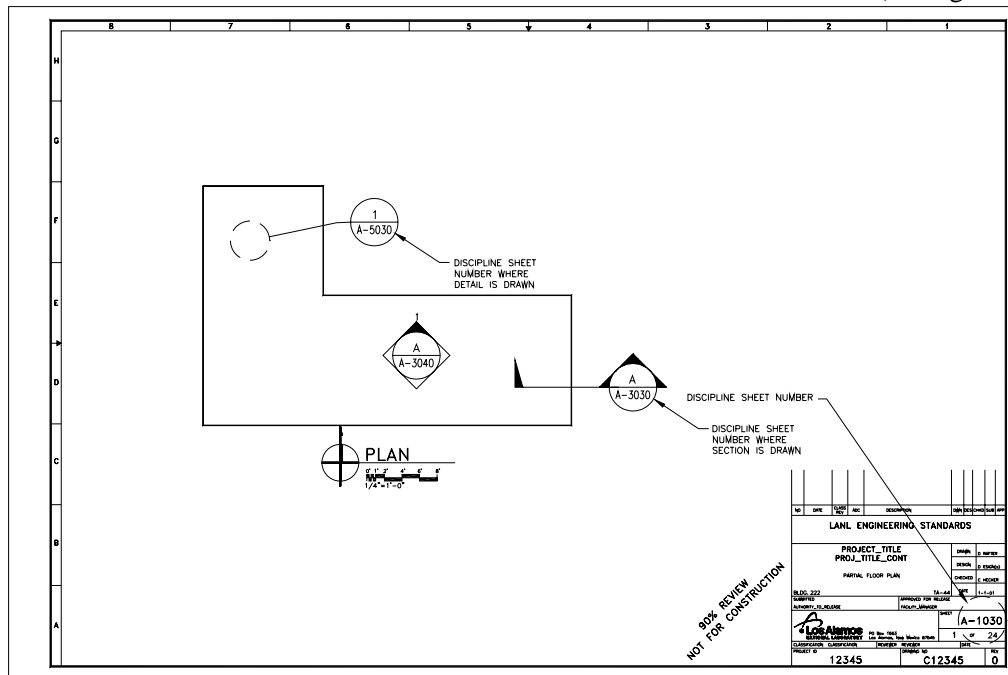


Figure 214-1

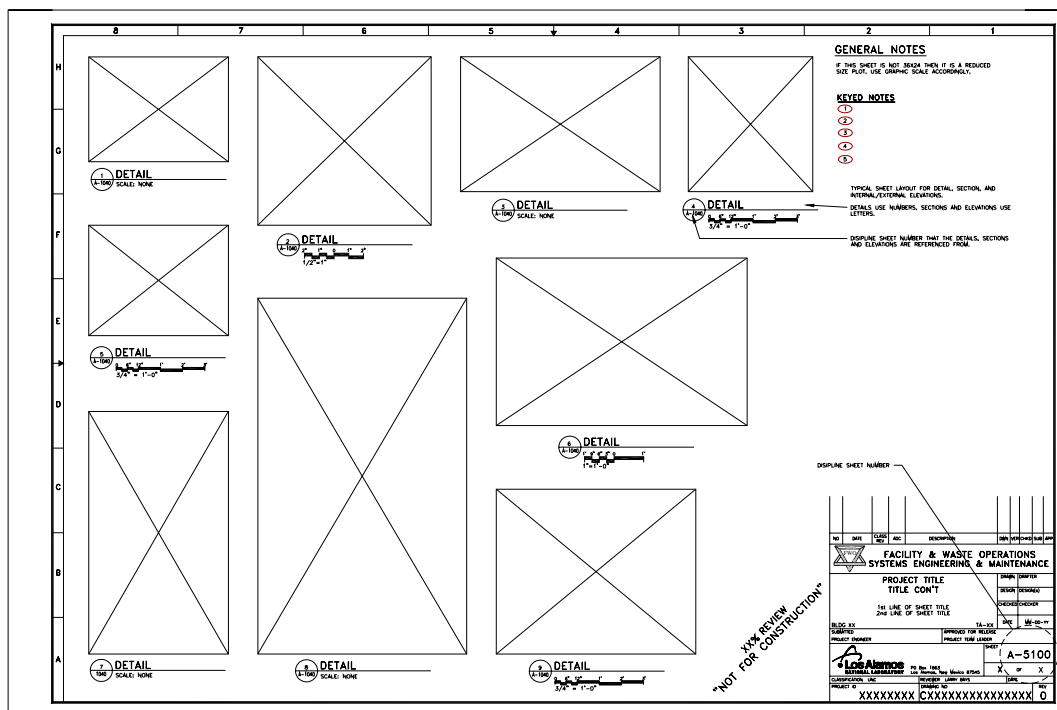


Figure 214-2

5.0 SECTION SYMBOLS

A. Standard Section Symbol:

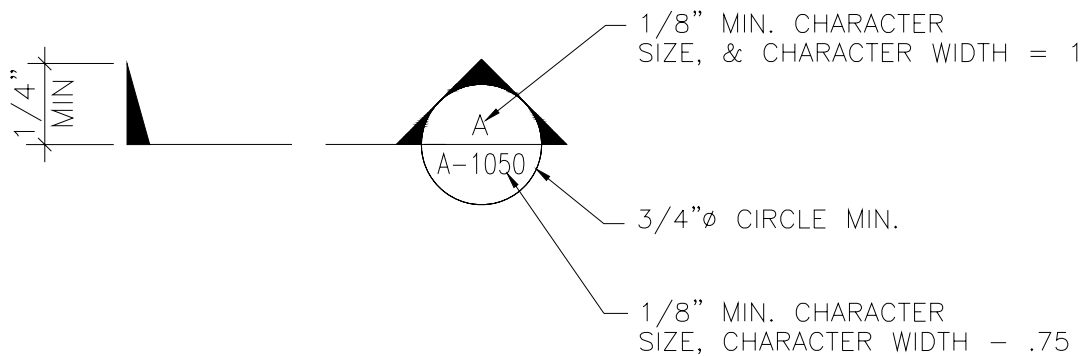


Figure 214-3

B. Acceptable Section Symbols when space for referencing is severely restricted:

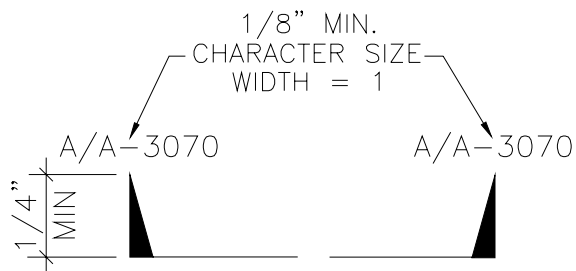


Figure 214-4

C. Detail Symbol

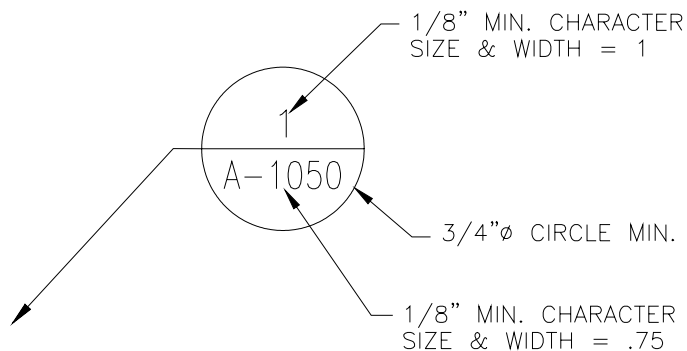
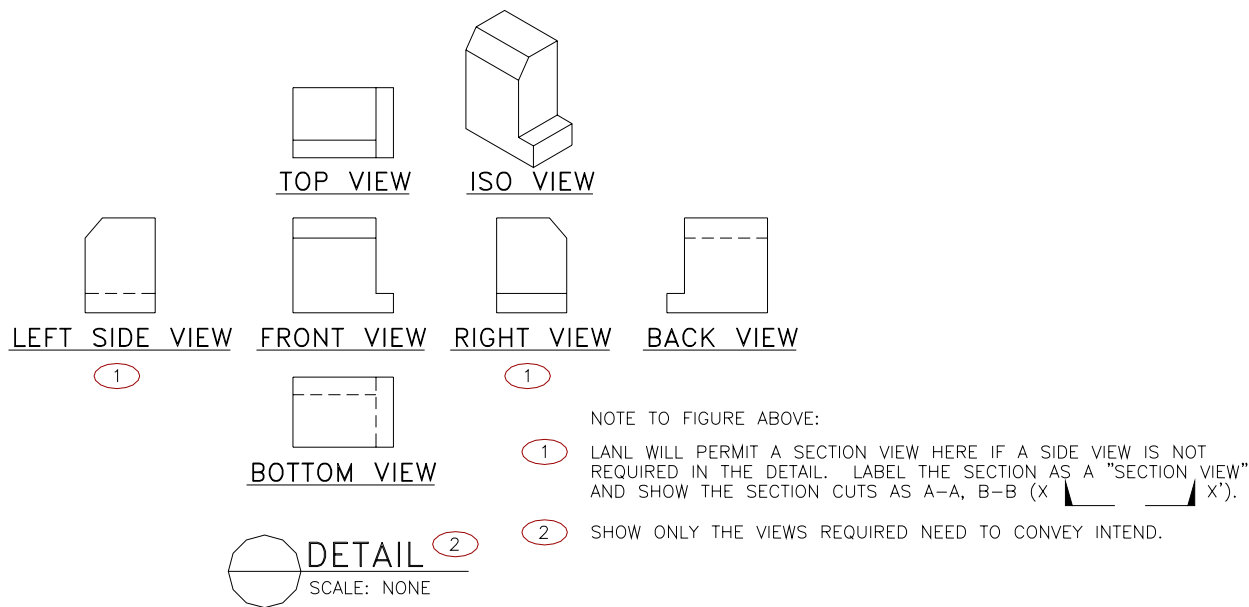


Figure 214-5

D. Detail Projection Element Method:



BASIS: GLOBAL ENGINEERING DOCUMENT 3-5

Figure 214-5A

6.0 SECTION, ELEVATION, AND DETAIL TITLES

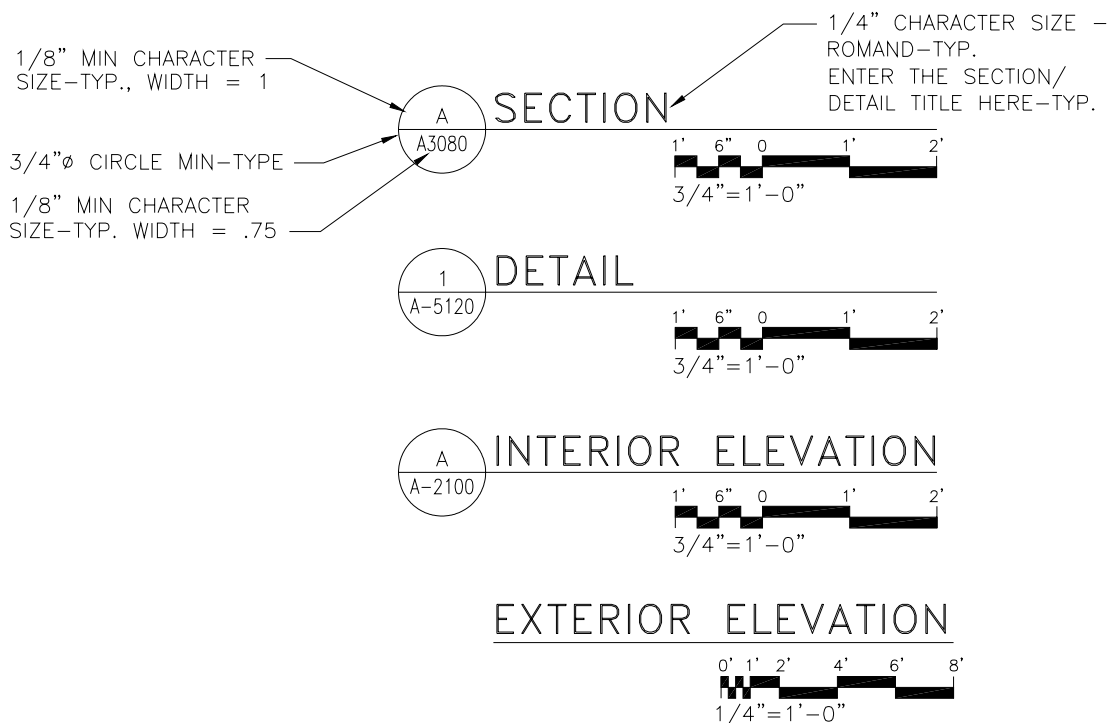


Figure 214-6

7.0 INTERIOR ELEVATIONS SYMBOL

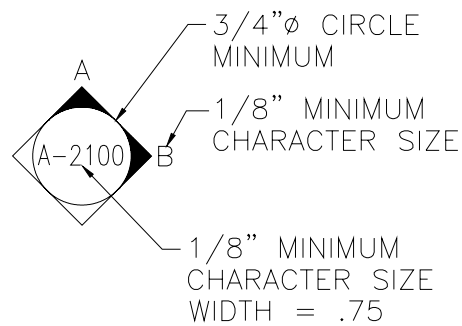


Figure 214-7

8.0 EXTERIOR ELEVATIONS

- A. Reference exterior elevations by the plan direction (i.e., North, South, East, and West).

9.0 KEYED NOTES

- A. Use keyed notes where space is limited in the drawing field. Keyed Notes shall be located below General Notes as shown in Figure 202.1.
- B. Number keyed notes independently by sheet, as opposed to consecutively by discipline or project.
- C. Begin numbering keyed notes on each sheet that contains keyed notes with the number one. Number each note sequentially in ascending order.
- D. If a keyed note is deleted, insert the comment "not used" in place of the deleted note or re-use the number for another note. It is not necessary to re-number keyed notes because of a deletion.
- E. When a keyed note is used, show the keyed note legend on the same sheet where reference is made. See Figure 202-1 for location of the Keyed Note legend.
- F. Do not use keyed notes for dimensions, air flows (CFMs), or under any other circumstances that are inappropriate.
- G. The keyed note symbol is an oval with a number designation. The standards established for text apply to the numeric character in the keyed note bubble. See Figure 214-8 for an example of the Keyed Note style. General Symbol G-46 and G-47 ([Appendix B](#)) establishes keyed note bubble size and "Keyed Notes" legend header.

H. The following is the example of the format for the keyed note legend.

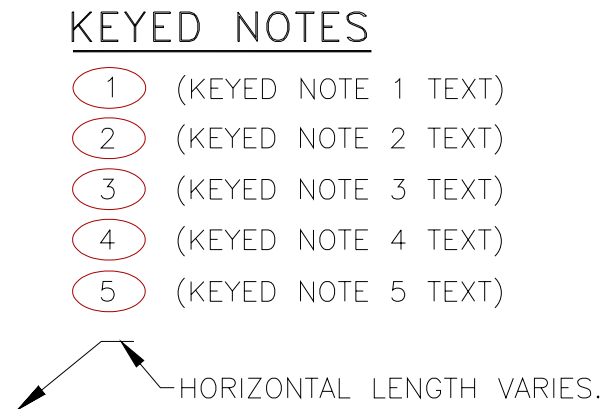


Figure 214-8

10.0 GENERAL NOTES ⁶

- A. When a General Note is used, show the general notes on the same sheet where reference is made.
- B. The General Notes legend shall be located above the “keyed note” legend as shown in Figure 202-1. Add plot size note. See Section 208.1C.
- C. The General Notes legend header shall be the same as the keyed note header established in General Symbol file number G-46 of [Appendix B](#).
- D. General Note headers should be 3/16” Romand.
- E. The following is the example of the format for the general note legend:

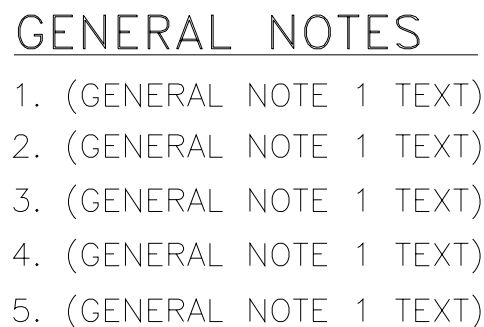


Figure 214-9

⁶ Basis: National CAD Standards.

215 ELECTRONIC CAD FILE CONVENTIONS

1.0 ELECTRONIC FILE NAMING CONVENTION

A. Each drawing file will be named accordingly:

- Project Identification (PI#) or Drawing # followed by the sheet identification number:

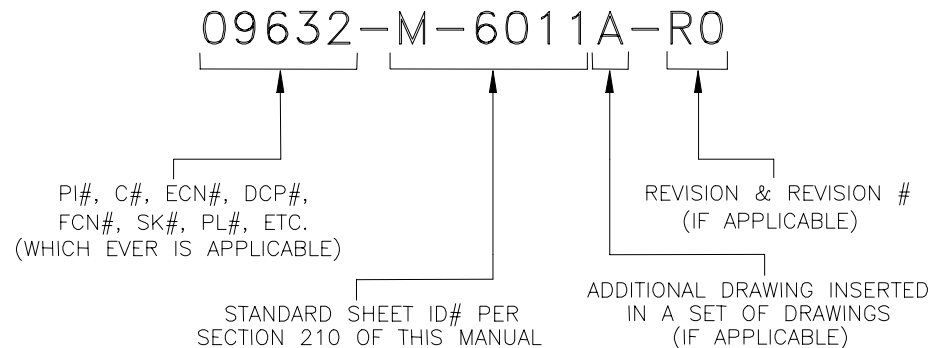


Figure 215-1

2.0 CAD LAYERING GUIDELINES

2.1 Maximum Number of Layers

A. Fifty (50) is the preferred maximum for the number of layers in a drawing file. In extreme cases, it is acceptable to increase the number of layers to a maximum of 100.

2.2 Layer Naming Convention

- A. Use the US National CAD Standard Version 2 (or later) AIA CAD Layer Guidelines for establishing layer names for all drawings. The only exceptions to those guidelines are:
1. The addition of a “G” (for general) group in the major groups. The “G” major group is added for general information that is not discipline specific, such as Title Blocks, Title Sheets, Submittal, and General Notes sheets and Symbols that are applicable to all disciplines.
 2. Do not exceed 16 characters in assigning any layer name. This allows for the addition of extra characters that are added to the layer name automatically when X-Refs are used and eventually bound to the file.

3.0 ELECTRONIC FILE FORMAT FOR FINAL DELIVERABLES

- A. One complete set of electronic files shall be placed on CD(s) and sent to FWO DCRM Team Records Center with a transmittal letter itemizing the contents and confirmation that the project has been approved and completely signed off for construction and as-builts.

- B. Affix a stick-on label to the CD with the following completed data:
- LANL Project ID#
 - LANL Drawing # (C#) or ECN#, DCP#, FCN#, SK#, or PL#
 - TA and Building
 - Title of Project
 - Number of electronic files submitted: X of X
- C. CD's that contain classified information shall be identified as such per S-7 and/or ADC instructions. **Note: FWO DCRM Team does not handle classified documents.**
- D. If another graphics software was used to create a drawing file, deliver the file in a format that can be recognized by and can be converted to AutoCAD (i.e.: ASCII format, DXF file).
- E. It is preferred that only standard AutoCAD Release 2000 or higher options be used in creating drawing files. Third party software that is completely compatible and supportable by AutoCAD Release 2000 or higher is acceptable.
- F. Not all contractors and subcontractors have AutoCAD release 2000 or above. All electronic files created in AutoCAD 2002 - 2004 shall be saved as AutoCAD 2000.
- G. The deliverable media for electronic files are CD disks. The entire project file can be stored on one CD, provided it fits. Label the disk with the official **PROJECT NAME, LANL PROJECT ID, DRAWING NO.(s), STAGE/PHASE** (Title II, Engineering Study, etc), **DATE SUBMITTED, ACAD VERSION/WORD PROCESSING PROGRAM** used to create the documents, **DESCRIPTION OF DOCUMENTS** contained on the disk. It should also be noted if any third party add on software packages were used to augment the standard AutoCAD package.
- H. A "read me" file is required if special instructions are needed for other users to understand the drawing files.
- I. Bind all externally referenced (X-REF) drawing files using the X-REF Bind command sequence and lock all view ports with the Lock Command. Refer to the AutoCAD Users Guide for instructions on binding x-refs.
- J. Identify the plotting scale on the drawing file as well as on the delivered media.
- K. It is not necessary to identify the plotting scale if it is 1:1.
- L. The preferred plotting scale is 1:1. If the scale is different than 1:1, then indicate the scale on the drawing file and the deliverable label.
- To minimize potting discrepancies for color; dithering; gray scale; pen assignments; screening; line-type; line weight; end styles; join styles; and fill styles, set the AutoCAD plot style to selection "2000-STD-Pens." Refer to the AutoCAD Users Guide, "Plotting Your Drawing" for assistance in setting this plotting style.
 - Shading (if required) in a drawing shall be done by using the standard AutoCAD Hatch Patterns.

- M. Final deliverables shall be “As-Built” documents with the conversion requirements implemented from Section 103, “As-Built Revision Procedures” of this manual.
- N. “Purge” all unnecessary blocks, text styles, and layers on all drawings prior to electronic FWO-DCRM Team submittals. Refer to the AutoCAD Users Guide for the “purging” procedure.

216 FOLDING DRAWING PRINTS

1.0 PRINT FOLDS

- A. *Guidance: Drawing sizes “B” through “E” and roll sizes are normally folded after printing to 8 1/2 x 11 inches to fit standard-size file folders and filing cabinets.*

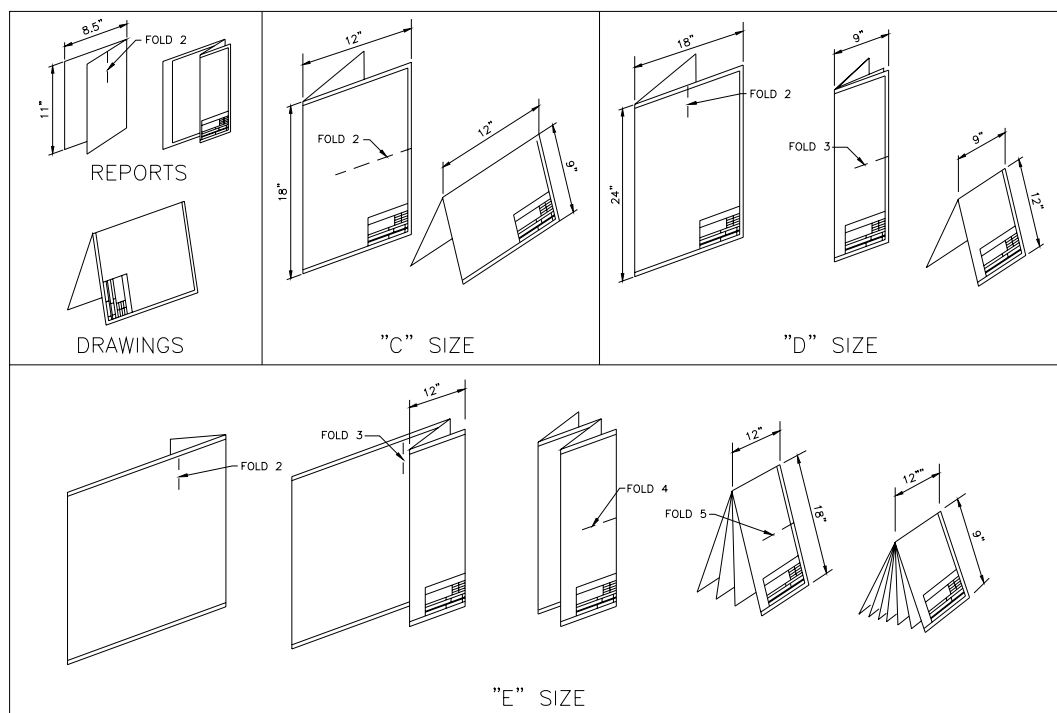


Figure 216-1, Global Engineering Documents (10th Edition)

ATTACHMENT 1 - FWO CONTACT INFORMATION

Request Type	Source	Contact	Main Phone Number
Project Identification No.	CMMS database <i>FWO-IIM Group</i>	CMMS Team	667-6068
Drawing no(s). (C#, PL#, etc.)	DCRM Team <i>FWO-IBS Group</i>	Document Control & Records Management	667-4696
Calculation no.	DCRM Team <i>FWO-IBS Group</i>	Document Control & Records Management	667-4696
SK no.	DCRM Team <i>FWO-IBS Group</i>	Document Control & Records Management	667-4696
DCP or ECN no. [IFMP-AP-ENG-002 & IFMP-AP-ENG-003]	DCRM Team <i>FWO-IBS Group</i>	Document Control & Records Management	667-4696
Drawing / construction project research	DCRM Team <i>FWO-IBS Group</i>	Document Control & Records Management	667-4696
Bldg. no.	Siting Committee <i>PM-1 Site & Project Planning Group</i>	Planning Services	665-5900
Technical Design Reviews [IFMP-AP-ENG-017 & IFMP-AP-DCRM-003]	FWO-Design Engineering & Construction Group	Design Review Project Leader	Group Office 667-4657
AP C[#] Calc DCP DCRM DECS ECN FWO IBS IIM LANL PI SK	Administrative Procedure Construction [number] Calculation Design Change Package Document Control & Records Management FWO-Design Engineering & Construction Services Group Engineering Change Notice Facility and Waste Operations Division FWO-Integrated Business Systems Group FWO-Integrated Information Management Group Los Alamos National Laboratory Project Identification Sketch		

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RECORDS OF REVISION

<u>Rev.</u>	<u>Date</u>	<u>Description</u>	<u>POC</u>	<u>OIC</u>
0	06/29/99	Document rewritten and reformatted to support LIR 220-03-01, Facility Engineering Manual. This chapter supersedes LANL Facility Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Symbols - generated & on-line; Civil – expanded; Structural – slight modification; Architectural, Mechanical, Electrical - expanded greatly; Mechanical and Electrical - also refer to LEM new examples.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>
2	07/15/02	Add new subsections (7.0 & 8.0) on Record Floor Plans. Correct Layering Table. Minor editorial changes as indicated by revision bars.	Richard Trout, <i>FWO-SEM</i>	Kurt Beckman, <i>FWO-SEM</i>
3	09/16/04	Added requirements for evacuation route diagrams, various plans: life safety, demolition, reflective ceiling, floor and roof plans of record; lightning protection drawings, plumbing and fire drawings. Addition of Attachment 1. Change from LEM to ESM (Engineering Standards Manual). Other editorial changes as noted by revision bars.	Richard Trout, <i>FWO-DECS</i>	Gurinder Grewal, <i>FWO-DO</i>

PLEASE CONTACT THE RESPONSIBLE ENGINEERING STANDARDS POC AND COMMITTEE
for upkeep, interpretations, and variance issues

LDM	Drafting Manual POC
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301 SYMBOLS

1.0 WHERE TO USE SYMBOLS

Use standard symbols on all drawings, whenever possible. *Guidance: The use of symbols can reduce the drawing time and clarify the drawings by the elimination of unnecessary details.*

2.0 SIZE OF SYMBOLS

Guidance: Symbol sizes can vary according to their use on drawings made “to scale” or “not to scale.” The size of symbols on drawings “not to scale” is dependent upon the complexity and aesthetics of the drawings.

3.0 SYMBOL TYPES

The LANL Drafting Symbols [Library](#) is not intended to be a complete listing of all possible symbols required for a project. Symbols may be created if not available in the LANL Drafting Symbols Library or in industry standard symbols. The Library’s symbols can be revised via controlled revisions by the Drafting Manual POC with Standards Manager approval (but without a Manual revision or Engineering Standards Board approval).

Identify symbols generated that are not in the LANL Drafting Symbols Library on the discipline legend with a (NS) “non standard” located to the right of the symbol description.

4.0 SYMBOL LIBRARY

- A. Symbols generated in the LANL symbol library are drawn 1:1. Insert accordingly, consistently, and to the proper size in relation to the drawing.
- B. Do not explode symbols with text to meet text requirement in Section 213.
- C. Symbols generated are from various National Standards. When discrepancies in symbols occur in the National Standards, only one was selected to be placed in the library.
- D. Symbols are revised on a regular basis. LANL will only indicate symbol revisions by notating the new revision number and date on the affected appendix, not on each individual symbol.

302 CIVIL DRAWINGS

1.0 DRAWING DESIGN PREPARATION

- A. Draw to scale and show north arrow symbol. Show dimensions including elevations in feet and decimals of a foot.
- B. Include in the site plan existing planimetric features such as buildings, roads, walks, parking areas, large trees, underground and overhead utilities, valve boxes, water meters, fire hydrants, pressure reducing valves, backflow preventers, thrust blocks, valve pits, and other features pertinent to the specific project.

- C. Refer to the mechanical drawings for lift stations, sumps, valves, etc. Include in the civil drawings site utilities outside building perimeters. *Electrical/communications site plans may be separated from the utilities plans providing they are carefully coordinated.*
- D. Prepare the site plan from a current survey tied to known survey markers located in accordance with the New Mexico State Plan Coordinate System (NMSPC), central zone, North American Datum 1983 (NAD), and mean sea level elevations. Provide appropriate drawing scale to clearly identify the project construction limits, planimetric features, and proposed improvements. Provide additional sheets with match lines if necessary. Include in the plan information necessary for layout of all elements of the new project.
- E. Include in the plans, or separate drawing, existing and new features including final contours clearly annotated at appropriate intervals; spot elevations; finish grades for drainage; site improvements; plan and profile of roads, walks, and drainage structures; test hole boring locations; and borehole data (if available).
- F. Include in the landscape and/or terrain management plan, a list of plant materials, fences, signs, erosion control measures, irrigation systems, berms, screens, gravel areas, lights, and other landscape features, amenities, and structures.
- G. Provide plan and profile drawing sheets for existing and new utility systems in the area surrounding the project. Prepare a plan and profile for new underground utility systems showing invert elevations, pipe slopes, and cover depths over the systems shown. *Provide scale of 1 inch equals 20 feet. Adjustments to the scale are allowed to improve clarity or to avoid excessive sheets and match lines.*
- H. Prepare design profiles for: sanitary sewers, storm drains, steam and condensate lines, roadways, drainage channels, and other facilities as required.
- I. Prepare earthwork cross sections for: roadways, parking lots and site grading.
- J. Prepare profiles or cross-sections for locations where new underground utility runs cross other existing utilities. Show new utility lines as continuous in profile with break lines provided to show changes in direction. Stationing for gravity sewers, storm drains and drainage channels shall progress up gradient where possible. Progress stationing from left to right on the drawing, preferably with the north arrow pointing up or to the right side of the drawing.
- K. Reproduce the soil boring logs and required notes on the drawings. Show borehole locations in plan view with accurate state plane coordinates, surface elevations and stratigraphic depth information.

2.0 GRADING AND SITE PLANS

Include the following:

- A. Existing utilities including type, size, and locations from field survey information.
- B. Existing permanent structures, roadways, fences, walks, retaining walls, and any additional planimetric features to clearly identify the work area.

- C. Manhole invert and rim elevations for existing sewers, storm drains, electrical manholes, and all other manhole types.
- D. New construction, items to be removed, and limits of work. Provide a site removal plan if appropriate.
- E. Clearing and grubbing areas.
- F. Existing contours, finished contours, and critical (existing and finish) spot elevations for proposed grading and paving improvements.
- G. Stationing, NMSPC coordinates or bearings and distances for location of facilities.
- H. Boring test holes and logs where applicable.
- I. Cross sections where major grading work is involved.
- J. Storm Water Pollution Prevention Plan (SWPPP) with proposed erosion control measures.
- K. Match lines of adjacent drawings.
- L. Fencing (standard or security).
- M. Pedestrian/vehicle circulation patterns, curb and gutter, parking layout, striping, permanent signing, and sidewalks.
- N. Location map.
- O. Traffic control plan including temporary construction signing and signals in accordance with the Manual of Uniform Traffic Control Devices.
- P. Stockpile and borrow areas.
- Q. Temporary laydown areas for the contractor's equipment.
- R. Security fence locations for "Bubbled Out" (space left blank for security purposes) areas.

3.0 LANDSCAPING PLANS

Include the following:

- A. Planting/irrigation.
- B. Recreational layouts.
- C. Visual screening.
- D. Plant species and size.

4.0 UTILITY PLANS

Include the following:

- A. Location of existing structures and facilities (no contours required).
- B. Location of all utilities and describe them as to size, type material, slope and indicate fittings.
- C. Proposed points of intersections of all utilities crossings for interference.
- D. Depth of cover for utilities.
- E. Details.
- F. Rim and invert elevations on sanitary sewer and storm drainage.

5.0 ROAD PLANS

Include the following:

- A. Geometric plan and profile, pavement markings, surfacing, thickness, cross section, and traffic control devices.
- B. Operational plan for vehicular circulation is required showing turnaround movements, ingress and egress.
- C. Centerline location, coordinates, or bearing and distances.
- D. Stationing.
- E. Curve data (show delta (D), radius (R), tangent (T), length (L), chord bearing (CH), point of curvature (PC), point of intersections (PI), and point of tangency (PT)).
- F. PC and PT stationing.
- G. PI coordinates.
- H. Typical roadway sections with pavement type and thickness, base and sub-grade materials, cross slopes, and taper details.
- I. Drainage culverts, size and type, ditches, and hillside interceptor benches and slopes. Include flowline elevations at culverts and slopes.
- J. Utility crossings.
- K. Horizontal alignment design parameters.

6.0 ROAD PROFILES

Include the following:

- A. Ground line (existing grade at centerline road).
- B. Finished grade (top of finished surface at centerline).
- C. Left and right curb profiles (if required).
- D. Longitudinal grades in percentages.
- E. Elevations at station intervals and vertical curves including: vertical point of curvature (VPC), vertical point of intersection (VPI), and vertical point of tangency (VPT).
- F. Elevations along vertical curve and tangents (if required).
- G. Vertical alignment design parameters.
- H. Drainage culverts & utility crossings.

7.0 ROAD, PARKING LOT, & SITE GRADING CROSS SECTIONS (LOOKING UP-STATION)

Include the following:

- A. Stationing, scales, and earthwork requirements.
- B. Centerline and/or baseline location.
- C. Existing ground line (phantom line type).
- D. Finished grade surface and bottom of base course (continuous linetype).
- E. Annotate cut and fill slopes.
- F. Ditch sections and structural features such as drop inlets, culverts, etc.

8.0 STORM DRAIN PLANS

Include the following:

- A. Existing underground structures including size, type, and location. (To be relocated or removed.)
- B. Existing storm drains, culverts, inlets, and outfall structures.
- C. Existing utilities.
- D. New storm drain location (including coordinates, distances, and bearings), stationing, curve data (show D, R, T, L, PC, PI and PT), manholes, transitions, and junction structures.

- E. Catch basin locations. (Tie to curb returns or centerline road stationing/offset), type, size, invert elevations).
- F. Pipe length, size, type, pipe slope, and end inverts.
- G. Utilities crossings - water, sewer, gas, steam, electric, telephone, etc.
- H. Unique trenching, shoring, benching, and/or backfill requirements.

9.0 STORM DRAIN (PROFILE)

Include the following:

- A. Ground line (existing grade at centerline storm drain).
- B. Street names, building designations, and existing structures.
- C. Existing underground utilities including sizes, types, interferences, and elevations.
- D. Centerline stationing, match lines, manholes, structures, design slopes, flow rates, and grade changes.
- E. Storm drain slope (ft/ft), invert elevations, length, size, type of pipe, centerline stationing, direction of connecting pipe inlets, and transition structures.
- F. Parallel existing storm drains.
- G. Parallel existing utilities.
- H. Concrete or other encasement for utility crossings.
- I. Details of crossings with existing utilities.

10.0 SANITARY SEWER PLANS

Include the following:

- A. Existing underground utilities, size, type, and location.
- B. Proposed sewer centerline geometry (coordinates, distances, and bearings), stationing, curve data (show D, R, T, L, PL, PI and PT), manholes (type and all callouts from standard drawings), and sizes.
- C. Encasement of sewer.
- D. Curbs, driveways, and sidewalks to be removed and replaced.
- E. Fire hydrants, valves, meters or other utility appurtenances to be relocated.

11.0 SANITARY SEWER PROFILES

Include the following:

- A. Existing ground line and proposed cover along center line of sewer.
- B. Substructures and/or utilities (parallel or crossing) including size, type, rim and invert elevations (excavated and checked, if required).
- C. Centerline stationing, match lines, manholes, structures, design slopes, flow capacity, and grade changes.
- D. Sewer profile slope and elevations, (ft/ft) and (ft), length, type, and diameter of pipe, centerline stationing, and direction of connecting inlets or Y branches.
- E. Parallel existing storm drains.
- F. Encasement for sewers.
- G. Details of crossings with existing utilities.

12.0 WATER SUPPLY AND DISTRIBUTION

Include the following:

- A. Location of all structures and facilities.
- B. Location, size and type of domestic water lines, valves, valve pits, meters, etc.
- C. Location, size and type of fire water lines, hydrants, post indicator valves, PRV's, storage tanks, valves, valve boxes, meters, and pits.
- D. Coordinates at all angle points of distribution lines.
- E. Bearing and distance between PT's.
- F. Show existing utilities and structures along alignment.
- G. Show section cut including invert elevations at all utility crossings.
- H. Horizontal/vertical alignment design parameters.
- I. Typical trench sections, bedding, and backfill requirements.
- J. Restrained fittings and/or thrust block locations and calculations.
- K. Horizontal geometry including curve data, if required, D, R, T, L, PC, PI and PT.

13.0 RADIOACTIVE LIQUID WASTE, CAUSTIC, ACID AND CHEMICAL PLANS, AND PROFILES

Include the following:

- A. Existing ground line and proposed cover over the piping.
- B. Substructures and/or utilities (parallel or crossing) including size, type, rim and invert elevations (excavated and checked, if required).
- C. Piping profile slope and elevations, (ft/ft) and (ft), length and type of pipe, size, station size, and direction of connecting inlets or Y branches.
- D. Monitoring system instrument and control
- E. Location of control valves, type, model number, and access requirements.
- F. Centerline stationing, match lines, manholes, structures, design slopes, flow capacity, and grade changes.
- G. Encasement for piping.
- H. Details of crossings with existing utilities.

14.0 CIVIL SYMBOLS

See Appendix C of this manual.

303 STRUCTURAL DRAWINGS

1.0 DESIGNATION OF COLUMN LINES

On the Plot Plan and Foundation Drawings, locate structures by coordinates or orthogonal offsets. The location of the base point coordinate shall be the intersection of the column lines in the northeast corner of the structure, where practical. The column line bearing and offset distance, or coordinate of an alternate column line intersection point shall be designated, see section 201.5.

2.0 STRUCTURAL STEEL FRAMING DRAWINGS

Framing Plans and Framing Elevations are schematic drawings. Show the centerlines of steel framing members as solid heavy lines stopping short of the member they frame into. Only show partial outlines of webs, flanges, and legs of members when necessary for clarity.

Example:

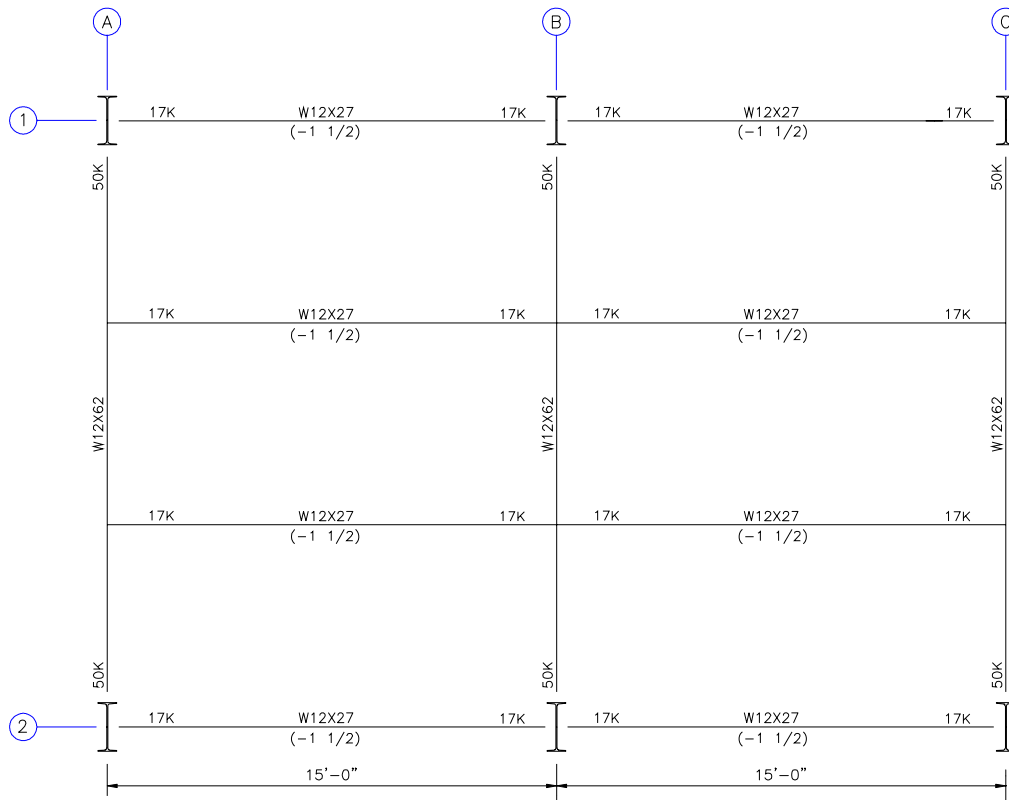


Figure 303-1

3.0 STRUCTURAL STEEL SHAPES

Label structural steel construction, per AISC M013, "Detailing for Steel Construction."

4.0 REINFORCED CONCRETE

Symbols commonly used on reinforced concrete drawings are:

- # To indicate size of deformed bar (superscript)
- Ø Plain rounds, e.g., spirals (superscript)
- @ Spacing center to center
- ↗ Direction in which bars extend
- ↔ Limits of area covered by bars

5.0 STRUCTURAL DRAWINGS

5.1 Dimensioning

On plan views, dimensions are to be tied into points that can readily be transferred to concrete, steel, and other drawings including plot plans. Clearly indicate match lines and centerlines of columns and equipment. When possible, keep dimensions outside the equipment and details. Dimension drawings in feet and inches.

5.2 Elevations

- A. Indicate elevations in decimals of a foot, e.g., EL 96.25. Indicate elevations on Superstructure Concrete and Steel Drawings in feet and inches, e.g., EL 115' - 6-1/2"
- B. Indicate floor and platform elevations to top of steel. Reference floor plate, top of grating or top of slab as + or - elevation to top of steel.
- C. Generally, the high point of the ground floor slab is to be the main vertical reference line.

5.3 Coordinates

On the Floor Plan and Foundation Drawing, locate structures by 2 sets of coordinates. The location of the coordinates shall be the intersection of the column lines and/or at corners of the structure, where practical.

5.4 Loads and Reactions

- A. Indicate the design loads for principal equipment supported on the drawings in their respective locations or in table format.
- B. Note Foundation Drawings with "Max Foundation Bearing Capacity = _____ lbs/sq. ft." Piling Drawings shall be noted with "Max Pile End Bearing Pressure = _____ lbs/sq.ft."
- C. Show floor and roof live loadings as well as wind and seismic design basis for future reference and for floor loading postings.

6.0 REINFORCED CONCRETE DRAWINGS

6.1 General

In general, the drafting practices shown in the ACI 315, "Details and Detailing of Concrete Reinforcement," published by the American Concrete Institute are acceptable.

6.2 Reinforcing

- A. Space reinforcing bars to the nearest inch, preferably, but in no case shall they be spaced closer than the nearest quarter-inch. *Call-out of bars should be in one view where practical.*
- B. Note bar spacing in inches, and inch marks are not to be used, e.g., #6 @ 18.

- C. Note bending details on the "Bending Schedule for Reinforcing Steel" where job requirements call for detailing the reinforcing. Show and identify bars cut in a section.

7.0 STRUCTURAL STEEL DRAWINGS

7.1 General

- A. The drawings prepared by the designer shall convey the information necessary for the preparation of erection and shop drawings by the steel fabricator.
- B. Indicate the type of construction, types of beams and columns, and all necessary data on loads, shears, moments, and axial forces to be resisted by all members and their connections on drawings.

7.2 Connection Guidance

- A. *Projects should be shop welded and field bolted where possible.*
- B. *Holes for field connections should be 1/16" larger in diameter than bolt. Holes in structural steel to match equipment hole locations should be made 3/16" larger in diameter than connecting bolts. Holes for anchor bolts in column base plates should be 5/16" larger in diameter than the bolt for 3/4" and 7/8" bolts and 1/2" larger for bolts 1" and over.*

7.3 Welding

- A. Make welding details and notes clear and complete. Provide the size, type, length, and spacing. Draw standard symbols and notations in accordance with the American Welding Society's standards AWS A3.0, Standard Welding Terms and Definitions, and AWS A2.4, Standard Symbols for Welding, Brazing and Nondestructive Examination. Several basic welding symbols are contained in Appendix K.

304 ARCHITECTURAL DRAWINGS

1.0 DRAWING DESIGN PREPARATION

- A. All building "plan" drawings at a minimum of 1/8" = 1' - 0" scale and preferably at 1/4" = 1' - 0" scale oriented as previously noted in this manual with a north arrow shown.
- B. All drawing dimensions are to be noted in feet and inches. Tick mark dimension line terminators are for Architectural drawings.
- C. All building elevations are to be drawn in the same scale as the building plan drawings.
- D. Main floor as 100' - 0" elevation on plan.
- E. All plans shall be in accordance with all approved applicable codes, IBC, ANSI, NFPA, and Factory Mutual.
- F. Where plans involve the addition to, or modification of, an existing structure, the existing structure plans shall be "As-Built" with corresponding building information included.

2.0 LIFE SAFETY PLANS

Including but not limited to the following:

- A. Show exits clearly.
- B. Travel paths from furthest distance to comply with codes.
- C. Pull stations.
- D. Fire extinguishers and cabinets.
- E. Emergency phones.
- F. Smoke detectors.
- G. Audio/Visual (A/V) devices.
- H. Handicap facilities.

3.0 DEMOLITION PLANS

Including but not limited to the following:

- A. Limits of demolition.
- B. Show particulate, noise, and visual barriers as well as traffic control barriers.
- C. Clearly note all equipment and material being removed or abandoned in place.
- D. Show evacuation paths from demolition area.
- E. Dimension as required.

4.0 FOUNDATION PLANS

Include the following:

- A. The foundation/building perimeter profile.
- B. Column lines.
- C. Location and profile of all slab/finish floor elevation changes.
- D. Hidden line indicating inside and outside of footing (as applicable).
- E. Hidden line indicating the thickness of monolithic slab turndowns (as applicable).
- F. Location of all piping sleeves.
- G. Building section cut symbols.

- H. Detail or detail section symbols.
- I. Plumbing fixturing and dimensions to centerline.
- J. Locations of all inserts duct trays, recessed electrical receptacles or other specialty items to be inserted into floor concrete.
- K. Dimensions.
- L. Exterior foundation perimeter.
- M. Locations of all offsets.
- N. Locations of all slab/floor depressions.
- O. Expansion joints.

5.0 FLOOR PLANS

Include the following:

- A. Perimeter walls drawn to scale.
- B. Column lines and exterior building columns.
- C. Interior walls drawn to scale.
- D. Plumbing fixturing and centerlines.
- E. Fixed in place partition walls (i.e., restroom partitions).
- F. Locations of windows (width) drawn to scale.
- G. Locations of doors with handing, size (width) and type of movement drawn to scale.
- H. Building section cut symbols.
- I. Detail section cut symbols.
- J. Enlarged plan or elevation identification symbol.
- K. Wall, interior elevation, detail symbols.
- L. Room numbers, symbols, and names (in renaming, check with an ADC for impact).
- M. Cabinetry locations, length and width drawn to scale.
- N. Mechanical, electrical, plumbing and fire protection equipment locations and rooms shown.
- O. Detail, elevation and section symbols shown drawn as per the requirements of this manual.

- P. Areas of enlarged plan shall be identified and referenced.
- Q. Finished floor elevation.
- R. Finished ceiling elevations.
- S. Overhead soffits and suspended equipment.
- T. Dimensions.
- U. Overall building with building additions to include existing building.
- V. Building offsets.
- W. Interior fixtures not dimensioned elsewhere.
- X. Sleeves in cast-in-place concrete walls.
- Y. Door number symbols.
- Z. Window type symbols.
- AA. Wall type symbols.
- BB. Room number symbols.
- CC. Floor drains.
- DD. Fire extinguisher cabinets.
- EE. Housekeeping pads.
- FF. Equipment (stoves, sinks, tables, etc.)
- GG. Ramps with arrows to show direction of slope.
- HH. Raised or recessed floor areas.
- II. Toilet partitions.
- JJ. Fire walls and rating (see Fire Protection section 307 and Symbols (Appendix D-1)).

6.0 REFLECTED CEILING PLANS

Including but not limited to the following:

- A. Show all ceiling finishes.
- B. All exposed structural materials.
- C. Layout of light fixtures.

- D. Direction and pattern of suspended ceiling.
- E. Dimensions as required.
- F. Soffits and chases.
- G. Skylights.
- H. Section and detail cuts.

7.0 FLOOR FINISH PLANS

Including but not limited to the following:

- A. Show patterns of floor finishes.
- B. Dimensions as required.
- C. Ramps, stairs, raised floor, and recessed floor areas.
- D. Housekeeping pads.
- E. Walls, columns, and toilet partitions.
- F. Section and detail cuts.
- G. Room names and numbers.
- H. Notes as required.

8.0 BUILDING ELEVATIONS

Including but not limited to the following:

- A. Approximate final grade line.
- B. Foundation extents identified by hidden line below grade line.
- C. All attributes of building elevations drawn to scale with window and doors having swings identified. Door and window symbols.
- D. Building section cut symbols.
- E. Detail section cut symbols.
- F. Enlarged plan or elevation area symbols.
- G. Each floor elevation and roof bearing elevation shall be identified as well as any changes within a floor line with a 0.050 broken line.

- H. All associated architectural features shall be shown that are relevant to the structure, i.e., finish changes, architectural finish features like inset stucco bands or tile, parapet coping exterior stairs (below grade shown as hidden lines) or free standing entry canopies.
- I. Expansion joints both building and finish. Stucco expansion joints shall be in conformance with the stucco manufacturer requirements.
- J. Building elevation dimensions.
- K. Floor to floor elevations.
- L. Floor to finish ceiling.
- M. Floor to roof bearing-primary or lowest point.
- N. Overall finished first floor to top of roof or roof parapet or mechanical parapet.
- O. Grade to first floor.
- P. First floor to bottom of lower level (as applicable).
- Q. Grade to bottom of footing or turndown.
- R. Independent features-length and width-marked for general notes by numerical symbol.
- S. Overall length.
- T. Any special features, i.e., overhangs and insets.
- U. Notations.
- V. Materials and types.
- W. Special identifications.
- X. Height elevations of window sills.
- Y. Horizontal dimensions as required.

9.0 BUILDING SECTIONS

Include the following:

- A. Drawn to scale minimum of $1/4'' = 1' 0''$ preferably $3/8'' = 1' 0''$
- B. All sectioned architectural / structural building systems and large components shown.
- C. All background architectural elevation features shown (interior elements).
- D. Primary systems materials section symbols shown.

- E. Vertical dimensions.
- F. Foundation to floor dimensions.
- G. Floor to floor dimensions.
- H. Floor system thickness.
- I. Primary bearing heights.
- J. Elements not vertically dimensioned elsewhere.
- K. Notations & Symbols.
- L. System or component call-outs.
- M. Circled and referenced to enlarged detail as required.

10.0 ENLARGED DETAILS AND PLANS

Include the following:

- A. More detailed information that cannot be accommodated on a smaller scaled drawing.
- B. Materials or components sectioned to show materials symbolically.
- C. Components shown sized and located to scale.
- D. Background components or features.
- E. All materials and components are to be noted and, where applicable, notations shall include height above grade as in plan view.

11.0 ROOF PLANS (CONSTRUCTION)

Including but not limited to the following:

- A. Show access areas.
- B. Overall dimensions.
- C. Roof type (construction type).
- D. Show slope direction.
- E. Pitch.
- F. Roof drains.
- G. Overhangs with dimensions.

- H. Penetrations and type (plumbing, HVAC, etc.)
- I. Penthouses.
- J. Parapet walls and heights.
- K. Fall protection anchor points.
- L. Roofing protected pathways for maintenance access to equipment.
- M. Skylights or roof openings.
- N. Solar energy equipment.
- O. Crickets.
- P. Scuppers.
- Q. Canales.
- R. Downspout locations.

12.0 FLOOR PLANS OF RECORD (FPR)

12.1 General Guidance

- A. *Floor Plans of Record are used as a baseline priority drawing for Facility Management, Space Planning, Space Management, Emergency Response, Emergency Evacuation Plans, Interior Design, As-Built Record Floor Plans, and Information drawings for outside Architects/Engineers for the development of construction drawings to existing facilities, geo-spatial information for Geographic Information Systems, and Title II design. (See §101.D, "General Definitions")*

12.2 Usage

- A. FPRs are not intended for use as construction drawings.
- B. FPRs are used as a baseline priority drawing for developing the following:
 - Facility Management.
 - Space planning.
 - Space management.
 - Emergency Response.
 - Emergency Evacuation Plans.
 - Interior design including systems furniture.
 - As-Built Record Floor Plans.

- Information drawings for outside Architects/Engineers for the development of construction drawings to existing facilities.
- Geo-spatial information for Geographic Information Systems.

12.3 Classification of Drawings

A. Classification:

1. All drawings will be submitted to an FWO Authorized Derivative Classifier (ADC) for classification prior to official release.

12.4 Priority Drawings

- #### **A. All drawings shall be considered Priority Drawings and noted as such on the standard LANL FPR title block.**

12.5 Verification of Accuracy

A. New and existing facilities:

1. All FPRs and RPRs may be reviewed and verified for accuracy through the FWO-Design Review process (contact [FWO-Design Engineering & Construction Services Group](#)).
2. After completion, the electronic CAD file will be submitted to FWO-IBS DCRM Team for recordkeeping. If revisions are necessary, the controlled electronic CAD file will be returned to contractor for modifications.

12.6 Types of FPRs

A. New Facility:

1. The FPR for a new facility shall be based on the Construction documents developed by the contractor of the new facility.
2. If no As-Built drawing is available, the new facility shall be field validated to an existing condition.

B. New Addition (or modification) to existing facility:

1. The FPR for the addition or remodel of an existing facility shall be based on the construction documents developed by the contractor of the work.
2. After the construction document is available, the new addition or remodel shall be field validated to its existing condition by FWO-DECS using the FWO space validation process.
3. Generate the FPR in accordance with this manual. This is to include modifications to buildings including room numbering, structure, room and wall configuration, and door and window removal/relocation.

C. Existing facility with no FPR:

1. Field validate the existing conditions of the facility.
2. Generate drawings in accordance with this manual.

D. Existing facility with current FPR:

1. Revise the existing FPR in accordance with this manual.

12.7 Format

A. Drafting:

1. The standard LANL FPR title block sheet shall be inserted in to paper space as an external reference. Plans shall be oriented on the sheet with the building lines parallel to the sheet borders.
2. All entities of an FPR shall be drawn at full scale in model space.
3. Plans will be drawn at the standard scales of $1/16'' = 1''-0''$, $1/8'' = 1''-0''$, or $1/4'' = 1'-0''$. A plan may be drawn to a scale of $1/2' = 1'-0''$ and labeled as an enlarged floor plan for small buildings where the standard scale would not show details properly (e.g., guard stations). The appropriate plan title and scale shall be inserted in paper space. The LANL ESM, Architectural Chapter 4, provides an example drawing (in development) ST4010A5, "Record Floor Plan".
4. If a floor plan is too large to be plotted on one sheet using one of the standard scales, the plan must be broken with the use of a "Matchline" in paper space. This process must be completed in paper space so the original building plan does not get broken or segmented. The building plan will not be broken at any time. The floor plan may be extended to a second or third sheet (tabs) if necessary in paper space. Matchline text to be $3/16''$ in paper space.

B. Dimensioning

1. There shall be only one dimension style. That style should be named LANL.
2. All dimensioning should be done in model space.
3. The settings are as follows:

Action	Setting
First and second arrowheads	Architectural ticks
Leader	Closed and filled
Arrow size	0.125 inches
Dimension text style	Dimension
Dimension text height	1/8 inch
Dimension text color	By layer
Dimension/extension line color	By layer
Primary units	Architectural
Precision	1/16 inch
Angular dimension units	Decimal degrees
Overall scale to be set accordingly to drawing scale used.	

(e.g., 1/8" scale uses overall scale of 96, 1/16" uses 192, etc.)

C. Sheet Numbering:

1. If a basement level exists, the sheet number shall be A-1000. If multiple basement levels exist, they shall be numbered consecutively by use of the Drawing number (e.g., FPR 000_0000_B1, B2, etc.)
2. The first floor plan of the FPR shall be numbered A-1001. The second floor plan of the FPR shall be numbered A-1002, and so on.
3. If it is necessary to break up the building into 2 or more sections with matchlines, the drawing numbering and tab numbering will be assigned as follows:
 - B1.1 – Basement level one (first section)
 - B1.2 – Basement level one (second section)
 - B2.1 – Sub Basement (first section)
 - B2.2 – Sub Basement (second section)
 - 01.1 – First floor (first section)
 - 01.2 – First floor (second section)
 - 02.1 – Second floor (first section)
 - 02.2 – Second floor (second section)

D. Drawing Electronic File Convention:

1. All FPR drawing files shall be named as follows:
[Floor Plan of Record][Technical Area]_[Building Number]_[Floor]_[Revision Number]
Example: FPR03_410_A-0.1.1_R0
2. All RPR drawing files shall be named as follows:
[Roof Plan of Record][Technical Area]_[Building Number]_[Floor]_[Revision Number]
Example: RPR03_410_A-0.1.1_R0

E. Grid References

1. Grids shall match the original construction documents developed by the contractor of the facility.
2. Column Line designations shall be shown on all sides of drawing as follows:
 - Horizontally, by letter, starting with "A." (From left to right).
 - Vertically, by number, starting with "1." (From top to bottom).
 - Letters 'I' and 'O' shall not be used.
3. The column grid lines shall extend through the entire drawing to the corresponding bubble.
4. FPR symbols and text shall be in accordance with the following standards:

- Grid bubble size of 1/2" diameter, 0.40 mm line width
- The grid line shall be a linetype of "CENTER", having line width of 0.18 mm.
- The grid line shall be color 13 and screened at 50%.
- The grid designator text shall be 1/4 inch high.
- The grid bubble must be an attributed block.

F. Font Styles and Text Size Requirements

1. Notes and all other text shall use the style named "LANL" using a Romans font. (Unless otherwise specified in this manual)
2. For scales of 1/8" = 1'-0" and above, all text shall be 1/8" high (including dimensions).
3. For scales of 1/16" = 1'-0", all text shall be 3/16" (including dimensions).
4. Text used for dimensioning shall be in the "Dimension" text style, and shall be the appropriate text height.
5. All text shall be oriented so that it reads horizontally from left to right and/or vertically from bottom to top.
6. Only the following text styles shall be used in any FPR drawing (All other styles must be purged from the drawing):
 - LANL
 - DIMENSION
 - ROMAND
 - ROMANS
 - STANDARD
7. Font width factor shall be 1.0 for all text

G. Lineweights

1. All layers will be given one of the following line weights (See attached layer table for assignments):
 - 0.18 mm
 - 0.25 mm
 - 0.40 mm
 - 0.80 mm (matchline only)
2. All FPRs shall have dimensions for the following:
 - Overall building length/width
 - Major building offsets
 - Grid spacing

12.8 Guidelines for Polylines

- A. The “GROS” layer will show the total constructed area of a building. Polylines are to be drawn in accordance with the standard method for measuring floor area in office buildings as outlined in ANSI/BOMA Z65.1–1996.
- B. The “RM” layer will show usable area and all common areas. Polylines are constructed per ANSI/BOMA Z65.1–1996, and shall outline the following areas:
 - All building usable and common areas
 - Vertical penetrations
 - Utility space
 - Office areas

12.9 Required Plan Elements

1. Exterior and interior wall construction type, thickness, and room number.
2. Retaining walls and thickness attached to building.
3. Columns and column center lines (Grid lines and numbers).
4. Permanent walls (rooms, hallways, corridors and vestibules) with room numbers.
5. Doors and door swing.
6. Windows – operable configuration addressed per keyed notes.
7. Wall openings that allow passage from one room to another and start at the floor line.
8. Stairways and attached handrails (include stair room number) (show direction of travel – up or down).
9. Utility chases.
10. Exterior wall louvers.
11. Pads at exterior door (concrete and wood).
12. Interior and exterior ramps. Show direction of slope, handrails, and curbs as required by code.
13. Attached docks and canopies.
14. Ladders – both interior and exterior.
15. Elevators and elevator numbers.
16. Built-in millwork and attached equipment.
17. Floor pits, trenches, and numbers.
18. Toilet room partitions and fixtures (plumbing etc.).
19. Overall building dimensions, wall thickness, and outside landing/dock dimensions.
20. Mezzanines and room numbers.
21. Fire wall location and identified with symbols per Appendix D-1 and D-2 (Fire Protection symbols).

22. Raised or recessed floor areas.
23. Columns and column center lines (Grid lines and numbers).
24. Systems furniture cubicles.

12.10 Use the following layering scheme in FPRs:

TABLE 304-1, LAYERING TABLE FOR FLOOR PLANS OF RECORD				
LAYER NAME	LAYER DESCRIPTION	LINE STYLE	COLOR / #	LINE WEIGHT
0	AutoCAD program layer used to import drawings and assign new FPR layers	Cont.	7	0.40 mm
A-COLS	Building columns	Cont.	4	0.40 mm
A-DIM	All building dimensions	Cont.	7	0.18 mm
A-DOOR	All doors and door swings	Cont.	1	0.25 mm
A-EXCONC.	Loading docks, door landings and edges of slabs.	Cont.	8	0.25 mm
A-GLAZ	Windows	Cont.	1	0.18 mm
A-GRAPHIC SCALE	Graphic scale and scale text, plan title, and North arrow	Cont.	3	0.25 mm
A-GRID	Grid line	Center	13	0.18 mm
A-GRID-BUBBLE	Grid bubble with text	Cont.	8	0.40 mm
A-LEVL	Level changes, ladders, ramps, pits, and depressions	Cont.	8	0.25 mm
A-MILLWORK	Built-in cabinets and counters	Cont.	11	0.18 mm
A-NOTES	All plan notes.	Cont.	7	0.18 mm
A-PIT	Pits in interior floors	Cont.	8	0.25 mm
A-PLMB	Toilet partitions and plumbing fixtures	Cont.	5	0.25 mm
A-STAIR	Stairs, railings	Cont.	9	0.25 mm
A-TABINFO	Title block notes & information	Cont.	7	0.18 mm
A-TX-RM NBR	Room name, number, and box	Cont.	1	0.25 mm
A-TX-SQ.FT.	Square footage text for room/area	Cont.	8	0.25 mm
A-WALL – EXTERIOR	Exterior building walls and attached retaining walls.	Cont.	4	0.40 mm
A-WALL – INTERIOR	Interior walls, partitions and fences	Cont.	3	0.40 mm
A-WALL-FIRE	Firewalls	Cont.	7	0.40 mm
A-WALL-FIREHATCH	Firewall hatching	Cont.	7	0.18 mm
DEFPOINTS	AutoCAD program use	Cont.	7	0.40 mm
GROS	P-line for external & internal gross areas			
MATCHLINE	Matchline	Phantom	5	0.80 mm
MATCHLINE-TEXT	Matchline text	Cont.	5	0.18 mm
RM	P-line for room areas	Cont.	5	0.18 mm

TABLE 304-1, LAYERING TABLE FOR FLOOR PLANS OF RECORD

LAYER NAME	LAYER DESCRIPTION	LINE STYLE	COLOR / #	LINE WEIGHT
VIEWPORT	Drawing viewport	Cont.	41	0.18 mm
X-24x36 A-TBLK	X-REF Title Block layer	Cont.	3	0.25 mm
X-24X36 A-TBLK-PRIORITY	X-REF Title Block layer	Cont.	7	0.18 mm

13.0 ROOF PLAN OF RECORD (RPRs)

13.1 General Guidance

- A. *Roof Plans are useful for security, lightning protection plans, and various other operations and maintenance needs.*
- B. *Produce RPRs in a manner similar to FPRs above.*

13.2 Sheet Numbering

- A. The RPR shall be the last sheet in the series of sheets. (If a building has three floors the last sheet will be A-1004).
- B. If it is necessary to break up the building into 2 or more section with matchlines, the sheet numbering will be assigned as follows:
 - R1.1 – Roof (first section)
 - R1.2 – Roof (second section)

13.3 Required Plan Elements

- A. The following shall be reflected in roof plans:
 - 1. Dimensions for major offsets and overall building length/width
 - 1. Roof type (construction type)
 - 2. Slope and Pitch
 - 3. Drain locations.
 - 4. Access locations and types (roof hatch, ladder)
 - 5. Overhang with dimension
 - 6. Penetrations
 - 7. Penthouses
 - 8. Parapet walls
 - 9. Walkpads
 - 10. Screen walls
 - 11. Roofing protected pathways for maintenance access to equipment, (i.e., extra roofing

material, roof pavers, and 2" x 4" walkways).

12. Roof edges

TABLE 304-2, LAYERING TABLE FOR ROOF PLANS OF RECORD

LAYER NAME	LAYER DESCRIPTION	LINE STYLE	COLOR / #	LINE WEIGHT
0	AutoCAD program layer used to import drawings and assign new FPR layers	Cont.	7	0.40 mm
A-GRAPHIC SCALE	Graphic scale and scale text, plan title, and North arrow	Cont.	3	0.25 mm
A-GRID	Grid line	Center	13	0.18 mm
A-GRID-BUBBLE	Grid bubble with text	Cont.	8	0.40 mm
A-ROOF-BLDG-BELOW	Line of exterior walls	Dashed2	11	0.18 mm
A-ROOF-ACCESS	Roof ladders and hatches	Cont.	?	0.25 mm
A-ROOF-DIM	All roof dimensions	Cont.	7	0.18 mm
A-ROOF-NOTE	All roof notes, text, and leaders	Cont.	7	0.18 mm
A-ROOF PENETRATION	Penetration & type, exhaust hoods, vents, etc.	Cont.	2	0.18 mm
A-ROOF-SCREENWALL	Protective screen for mechanical, equipment, and fences	Cont.	1	0.18 mm
A-ROOF-WALKPADS	Roof walkpads	Cont.	3	0.18 mm
A-TABINFO	Title block notes & information	Cont.	7	0.18 mm
A-TX-RM NBR	Room name, number, and box	Cont.	1	0.25 mm
A-TX-SQ.FT.	Square footage text for room/area	Cont.	8	0.25 mm
DEFPOINTS	AutoCAD program use	Cont.	7	0.18 mm
MATCHLINE	Matchline	Phantom	5	0.80 mm
MATCHLINE-TEXT	Matchline text	Cont.	5	0.18 mm
VIEWPORT	Drawing viewport	Cont.	41	0.18 mm
X-24x36 A-TBLK	X-REF Title Block layer	Cont.	3	0.25 mm
X-24X36 A-TBLK-PRIORITY	X-REF Title Block layer	Cont.	7	0.18 mm

14.0 MISCELLANY

A. Title Block:

1. Room Information Chart: If the room information chart is too big to fit within the title block it will be placed on its own sheet. It will then become the first sheet in the sheet package.

B. Key Plan:

1. If the building must be broken using Matchlines, a key plan is required that reflects

which portion of the building is shown on any given sheet.

- Key plans will be located at the upper right corner of the title block, and will utilize a 3 inch by 5 inch area.
- A corresponding Title Bar will be associated with each key plan. It will be entitled “Key Plan”, contain a North arrow, and will specify that the key plan doesn’t conform to a scale by notating “No Scale”.
- Key Plans and FPR drawings shall be oriented identically.

C. Title Block Usage:

1. LANL FPR title blocks should be used for internal use only. If the drawing file should be sent to external recipients, the LANL FPR title block should be removed from the drawing file.

14.1 Architectural Stamp

A. Layout Space Requirements:

1. Viewports shall be created to allow for a 2 inch by 2 inch stamp in the lower right-hand corner of the drawing area. These are issued by the State to Architects and Engineers to certify their approval of drawings.

15.0 EVACUATION ROUTE DIAGRAM (ERD) ¹

A. Use the most current floor plan of record (FPR) to generate an evacuation route diagram.

B. Verify accuracy of FPR prior to generating ERD. Correct deficiencies in FPR and notify FWO-Facility Planning (FP), FWO-DECS, FWO-IBS DCRM Team, and the Facility Manager.

C. Evacuation route diagrams shall contain the following element locations:

- Fire extinguishers
- Fire alarms
- Emergency lighting
- Evacuation routes (primary in Red continuous line type with flow arrows, secondary route in Blue, dashed line type, pen).
- Fire horns
- Fire alarm pull boxes
- Muster area locations (Primary and Secondary as required) (Coordinated by Emergency Response Management and Facility Management).
- Legend of symbols (permitted on actual ERP/EEP sheets).
- Current “24-Hour Emergency Contacts” sign.

¹ Basis: ASTM E-2238-02.

- Exit signs
- First aid kits
- “YOU ARE HERE” notation with a solid red circle 1/4 inch in diameter.
- Temporary shelters should be marked by dashed double red lines, shaded in gray, and labeled “TEMPORARY SHELTER” in 1/8 inch text height in Romand font.

D. ERDs are:

- Considered “Priority Drawings”
- Not required to be drawn to scale, but to fit on one sheet per floor or evacuation area.
- Drawn on “C” size paper and framed per LANL’s picture framing Just-In-Time (JIT) contractor criteria.
- To be wall mounted at locations or prescribed by the Facility Manager and/or ASTM E-2238.
- Mounted 48 inches to 60 inches above finished floor to the center of the sign.
- To follow LANL Drafting Manual guidelines unless otherwise specified.
- To show north orientation in relationship to wall posting.

16.0 ARCHITECTURAL SYMBOLS

- A. Symbols used in the AIA Architectural Graphic Standard (AGS) are of such a large number it would be impractical for LANL to create an architectural symbol library and place them on-line. Therefore, the LANL Symbol Library located on the World Wide Web does not address architectural symbols.
- B. Use the current edition of the Architectural Graphic Standards for:
1. Materials in Large scale section and Graphic representation.
 2. Materials in Small scale Plan Views and Graphic representation.
 3. Surfaces at Small scale and Graphic representation.
 4. Surfaces at Large scale and Graphic representation.

305 MECHANICAL DRAWINGS

1.0 MECHANICAL DRAWINGS

- A. Mechanical Drawings are to include plans, elevations, sections, details, and equipment schedules/lists to clearly define the mechanical requirements of the project.
- B. For symbols used in Plans, Sections, Elevations, Details, and Isometrics, use the standard mechanical symbols found in this manuals [Appendices](#) (Appendices E1 to E3).
- C. Use double-line piping in highly congested areas as necessary to clarify the construction.

- D. Use double-line ductwork, except where not permitted by Project Engineer. Show diffusers, grilles, and registers with sizes, flow rates and directions of flow noted on the drawings or in a schedule. Indicate all thermostats/sensors, duct mounted controls, control panels, etc., on the ductwork drawings.
- E. Place fire protection piping drawings on separate sheets and do not include with other piping system drawings, except as may be specifically permitted by Project Engineer.
- F. Include control diagrams and sequence of operations in the mechanical drawing set, if requested by the client.
- G. Individual large scale mechanical equipment room plan and sections as well as mechanical details shall fully detail the design.
- H. Draw mechanical equipment to scale with required maintenance and tube removal spaces outlined. Ensure that the equipment can be installed and/or removed without having to dismantle or remove other equipment or permanent construction.
- I. Indicate the outline of electrical equipment, including working space clearance, on the mechanical drawings (equipment room, plans, etc.) to ensure that the mechanical equipment does not interfere with the electrical equipment working space as required by the NEC. Do not locate mechanical equipment/piping (i.e., water piping, ductwork, pumps, etc.) above switchboards, panel boards, and motor control centers. Consult with the electrical section designer for the applicable code clearance requirements.

2.0 PROCESS FLOW DIAGRAMS (PFDs) & PIPING & INSTRUMENT DIAGRAMS (P&IDs)

- A. For engineering requirements pertaining to P&ID diagrams, refer to ESM, Chapter 6, Section 310.
- B. Refer to the PFD/P&ID Drafting Symbol Library, Appendix G1-G3 of this manual, for drafting symbols to be used in PFD and P&ID.
- C. On PFDs and P&IDs indicate (at a minimum) the items as defined in the ESM, Chapter 6, Section 310. Text to be 1/8" high, color white (7), 0.35 mm (0.015") thick.
- D. *P&IDs may extend beyond the drafting field for clarity purposes only. Refer to DSM Section 202.3.0.g, Drawing Title Blocks.*
- E. Do not cross control runs. Break secondary signals, not the process line.
- F. Make flow arrows 1/4 inch.

G. Process Flow Diagram and P&ID Layering Convention modified for LANL use from UDS:

LAYER NAME	DESCRIPTION	COLOR	LINE WIDTH
MI-PC	Main and/or Primary instrument supply or process	13-14	0.70 mm (0.030")
MI-SE	Secondary Systems = Bypasses	1-4	0.50 mm (0.02")
MI-SY	Symbol inserted from the symbol or created on the sheet, plan breaks, continuation flags	7	0.35 mm (0.015")
MI-TX	Text typed or inserted	7	0.35 mm (0.015")
MI-PS	Pneumatic signals	5-8	0.35 mm (0.015")
MI-ES	Electric, electromagnetic, sonic signals	5-8	0.35 mm (0.015")
MI-HS	Hydraulic signals	5-8	0.35 mm (0.015")
MI-US	Undefined signals	5-8	0.35 mm (0.015")
MI-HT	Heat trace	5-8	0.35 mm (0.015")
MI-SL	Software or data link, internal system links	5-8	0.35 mm (0.015")
MI-EL	Mechanical links	5-8	0.35 mm (0.015")
MI-CT	Capillary tube	5-8	0.35 mm (0.015")
MI-WB	Wall barrier	5-8	0.35 mm (0.015")
MI-EX	Existing equipment, systems, components, lines, text, symbols, etc.	9	0.25 mm (0.010")
MI-BL	Buried lines	9	0.25 mm (0.010")

H. *The system flow should generally be from left to right and from top to bottom.*

I. Draw PFD & P&IDs to a scale of 1:1 but labeled as "scale: none" on the drawing.

J. Draw PFD & P&IDs with a snap of 1/16 inch.

K. *For systems having various parameters of operation it is recommended on PFDs that a "Parameter Chart" be shown. The chart should appear on the bottom of the drawing designated for Keyed Notes and General Notes. Layer Text to be 1/8 inch in height, chart outline and vertical columns to be 0.50 mm, 0.025 mm for horizontal lines. Example of a parameter chart as follows:*

Condition #1 = maximum allowable working condition; Condition #2 = normal operating condition; Condition #3 = minimal allowable working condition.

OPERATING CONDITION		KEY COMPONENTS			
		1	2	3	4
CONDITION #1	FLOW	20,000 CFM			
	PRESS	3.5" H ₂ O			
	TEMP	100°F			
CONDITION #2	FLOW				
	PRESS				
	TEMP				
CONDITION #3	FLOW				
	PRESS				
	TEMP				

Figure 305-1

- L. Use table form, using parameters at identified locations on process lines as “Keyed Notes.”
- M. *PFDs may also warrant a mass flow/balance table.*
- N. For symbols required for a PFD and/or P&ID not found in the General Instrument or Function Symbols legend, refer to ISA 5.1. If a symbol is created for a specific project not found in ISA 5.1, create the symbol, add the symbol to the Symbol Legend, and identify the symbol(s) as “non-standard” (NS).
- O. New layers following AIA layering convention per NCS for system specific layouts (i.e., compressed, radioactive liquid waste, tritium, etc.).

3.0 MECHANICAL EQUIPMENT LIST

Example:

MECHANICAL EQUIPMENT LIST				
ITEM NO.	LOCATION RM.NO.	NO. REQ'D.	DESCRIPTION, MANUFACTURER OR APPROVED EQUAL	FURN. BY
1	RM 100	1	PUMP	CONTR

Figure 305-2

- A. Provide a mechanical equipment list for projects required by client.
- B. Provide an equipment list for each individual discipline set (HVAC, plumbing, fire protection, etc.) and locate the sheet in the discipline drawing set as outlined in Section 211 of this manual.
- C. Indicate mechanical equipment items by an item number in a diamond. The item numbers shall be in sequence for the entire mechanical drawing set.
- D. Note in the “FURN. BY” column, if the equipment is furnished by the contractor (CONTR) or Government Furnished Equipment (GFE).

4.0 MECHANICAL SYMBOLS

- A. Use applicable graphics symbols on drawings and include a mechanical legend on the first sheet of the mechanical drawing set.
- B. *Pipe fitting symbols are depicted without a joint connection symbols. The joint symbol is optional; however, the symbols should be consistent throughout the entire mechanical drawing set. It is also preferred to note the type of joint (welded, soldered, flanged, etc.) in the specification and not by use of a symbol.*
- C. Where weld symbols are shown, make welding details and notes clear and complete. Draw standard symbols and notations in accordance with the American Welding Society's standards AWS A3.0, Standard Welding Terms and Definitions, and AWS A2.4, Standard Symbols for Welding, Brazing and Nondestructive Examination. Several basic welding symbols are contained in Appendix K.

306 ELECTRICAL DRAWINGS

1.0 GENERAL

- A. Refer to ESM Chapter 7, Section D5000, for discussion of development and a typical one-line diagram.
- B. Use Example Drawing D5000-1, Legend and General Notes, as the starting point for the electrical drawing set legend.
- C. Do not use General Notes on projects that include construction specifications.

2.0 ONE-LINE DIAGRAMS

- A. Use symbols and blocks in accordance with Appendix F of this manual.
- B. Make text 1/8" high, color white (7), 0.35 mm (0.015 inches) thick. Exceptions:
 - 1. Panel designations (i.e., SWB-A, PP-1, etc.) shall be 3/16 inch, AutoCAD font Romand.
 - 2. Items listed in Section 213.2.G.
- C. *One-line diagrams may extend beyond the drafting field (Reference Section 202.3.G) for clarity purposes only.*
- D. Existing conditions to be 0.25 mm (0.010 inches) line width, new conditions to be 0.70 mm (0.030 inches) line width.
- E. *Avoid crossing circuit runs.*
- F. Use conventional drafting standards if one-line diagram continues to another sheet.
- G. Line type for existing conditions: Phantom for conduit wiring and equipment - dashed for enclosures.

- H. Line type for new conditions: Continuous for conduit, wiring and equipment - dashed for enclosures.
- I. Organize drawing to be read from top to bottom. Text read horizontally or vertically, read from the right side of the sheet.
- J. Data input on separate layers (use AIA CAD layering convention). Refer to Section 212.D, Basic Line Widths, for line weight and type.

EXISTING & NEW

Text

Wiring

Conduit

Enclosures

Equipment

- K. Equipment shall be associated with the room number in which it is located.
- L. Refer to ESM Chapter 7, Example Drawing D5000-2, One-Line Diagram.

3.0 ELECTRICAL EQUIPMENT PLANS

- A. Show working clearances for all electrical distribution equipment.
- B. Show equipment plans on separate drawings as follows:
 - 1. Power Plan
 - Major electrical distribution equipment, motors, and major electrical loads
 - 2. Receptacle Plan
 - Receptacles and circuiting
 - Locations of the branch circuit panels
 - 3. Lighting Plan
 - Lighting fixtures, switches, and circuiting
 - Emergency and exit lighting fixtures and circuiting
 - Location of the branch circuit panels
 - 4. Special Systems Plan
 - Telecommunications outlets
 - Telecommunications rooms
 - Fire Alarm System
 - Security equipment
- C. Use standard symbols and blocks in accordance with Appendix F of this manual.

4.0 WIRING DIAGRAMS

- A. Refer to ESM Chapter 7, Example Drawing D5020-1, Motor Control Wiring Diagrams.
- B. Show the connection of an installation or its component devices, controllers', and equipment.
- C. A wiring diagram may cover internal or external connections, or both, and shall contain such detail as is needed to make or trace connections that are involved. *It usually shows the general physical arrangement of devices and device elements and also accessory items such as terminal blocks, fuses, power supplies, etc.*

5.0 ELECTRICAL SCHEMATICS

- A. Requirements: Use standard symbols and blocks in accordance with Appendix F of this manual.
- B. *Guidance:*
 - 1. *Refer to ESM Chapter 7, Example Drawing D5020-1, Motor Control Wiring Diagrams and D5000-2, One Line Diagrams.*
 - 2. *Schematic diagrams show, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component device or parts.*
 - 3. *Schematics are intended to show major components and the flow of electrical power and control.*
 - 4. *Schematics are not intended to show wire sizes or terminations, etc.*

6.0 ELECTRICAL SCHEDULES

- A. Refer to ESM Chapter 7, Section D5010.2.7, Figure D5010-1 or its successor, for typical schedules.
- B. Use standard symbols and blocks in accordance with this manual.

7.0 LIGHTNING PROTECTION SYSTEM (LPS)

- A. Lightning protection drawings are considered "priority drawings".
- B. Use the lightning protection symbols furnished in this manual.
- C. Use existing roof plans of record (RPR) or generate new drawings to indicate LPS.
- D. *Guidance: Use example drawing D5090-1 (in development) as template for elements to be shown on the drawing.*
- E. Reference other disciplines if coordination is required either in Key Notes or General Notes.
- F. Show LPS for: stacks, VTRs, mechanical equipment, roof drains, ladders, hatches, and access ways, etc.

Basis: NFPA 780.

307 PLUMBING

1.0 GENERAL

- A. Water distribution and waste/vent disposal systems shall be shown on the same plan as they occur servicing the fixtures on the floor represented.
- B. Waste lines shall be drawn – continuous line type, 0.8 mm.
- C. Vent lines shall be drawn – dashed line type, 0.35 mm.
- D. All line types on plumbing systems shall have breaks indicating the type of systems (i.e., - RD -, - S -, - CA -, -- V --, etc.)

2.0 PLUMBING SYSTEMS

- A. Plumbing systems are comprised of:
 - 1. Water: potable, non-potable, grey, soft, distilled, deionized, chilled drinking fountain, make-up.
 - 2. Compressed Air
 - 3. Natural Gas
 - 4. Waste: sanitary, roof drain, overflow roof drain, septic, indirect drains, acid, industrial
 - 5. Fuel oil
 - 6. Petroleum
 - 7. Vacuum
 - 8. Steam and Condensate
 - 9. Vent

Note: Some systems listed above that are connected to plumbing equipment may require interface coordination with other disciplines. These interfaces may need to be reflected in System Design Descriptions (SDD), if applicable.

Basis: American Society of Plumbing Engineers.

3.0 ISOMETRICS AND SCHEMATICS

- A. Isometrics and schematics shall depict the following:
 - 1. pipe size
 - 2. pipe material
 - 3. direction of flow
 - 4. system type (V=vent, S=sanitary waste, etc.)
 - 5. equipment/fixture identifier
 - 6. room numbers where equipment/fixture is located

7. location of piping by keyed note
 8. access panels
 9. slope with pitch arrow including fall expressed in fraction-of-an-inch per foot length of pipe (on main runs)
- B. Isometrics shall appear in the P-9000 series, schematics/diagrams in the P-6000 series.
- C. Isometrics/diagrams for new systems shall show the entire system layout. Several systems may appear on the same sheet.
- D. Plumbing equipment schedules shall appear in the P-7000 series.
- E. Plumbing fixture/equipment identifier system:

P-1 water closets	P-6 kitchen sinks
P-2 urinals	P-7 service (janitor) sinks
P-3 lavatories	P-8 water heaters
P-4 showers	P-9 hose bibs
P-5 drinking fountains/water coolers	P-10 to P-? user defined
Note: Use suffixes to depict variations to the fixture selection (i.e., P-3A counter top handicap, P-3B wall hung, P-4A handicap, P-7A pedestal type, etc.)	

308 FIRE PROTECTION DRAWINGS

1.0 DRAWING DESIGN PREPARATION

- A. Draw to scale and show north arrow symbol. Show dimensions, including elevations in feet and decimals of a foot.
- B. Include on drawings, plans and site plans existing features such as buildings, roads, walks, parking areas, large trees, underground and overhead utilities, valve boxes, water meters, fire hydrants, pressure reducing valves, backflow preventers, thrust blocks, valve pits, and other features pertinent to the specific project.
- C. The types of plans required for preparing a fire protection drawing set include floor plans, reflected ceiling plans, elevations, sections, isometrics, schematics and schedules. Reflected ceiling plans should show locations of lights, diffusers and other devices installed at the ceiling. Related plans should show ductwork layout. Include within each submittal all symbols, legends, and notes needed to understand everything shown on the drawings. See Section 2.0.

- D. The information to be shown on the working plans for installing fire protection systems is listed in Sections 3.0 through 7.0. Related information that is normally handled in other drawing sets is listed in Section 8.0.
- E. Support the information shown on the drawings with a detailed Bills of Materials listing numbers and types of all devices provided. The Bill of Materials can be incorporated on the drawings or can be separate. It should match the manufacturers' literature submitted for the project.
- F. Fire protection project drawings include those showing building structural features, emergency lighting, fire alarm systems, special extinguishing systems, sprinkler systems, and fire protection water supplies. For some projects, other types of drawings could be included.
- G. Fire protection symbols (Appendix D) per NFPA 170.

2.0 BUILDING ARCHITECTURAL AND STRUCTURAL FEATURES

- A. Show in plans the building architectural and structural features relating to fire and explosion resistance. These features include, but are not limited to:
 - Location of fire barriers (walls/floors/ceilings)
 - Material, thickness, and rating of fire barriers
 - Location and height of parapets
 - Roof construction
 - Rated fire doors/hatches
 - Penetrations of fire barriers and any protection provided for those penetrations
 - Fire- or explosion-resistant construction details including fireproofing on structural members
 - Location, construction, and size of concealed spaces, attics, closets, bathrooms, and other small enclosures
 - Locations and heights of unrated walls and partitions
- B. Some of these features will need to be coordinated with Site, Structural, and Architectural drawings. Some of these features will also need to be shown on the drawings for Sprinklers, Egress Routes, and Special Extinguishing Systems.

3.0 EMERGENCY LIGHTING

- A. Include in plans for emergency lighting all the elements required by NFPA 101. Plans should cover the following:
 - Type of lighting provided
 - Location of lights
 - Conduit routing
 - Dedicated outlets

- Wiring schematic
- Type of back-up power provided

4.0 FIRE ALARM SYSTEMS

- A. The fire alarm system designer should prepare working plans that show the features described in NFPA 72. Drawings for fire alarm systems should include:
1. Locations and types of all fire detectors (heat, smoke, flame, gas detection, etc.).
 2. Locations of manual pull stations.
 3. Location and type of fire alarm panel and auxiliary panels.
 4. Locations of notification appliances.
 5. Candela rating of visible notification appliances.
 6. Locations and types of remote annunciators and graphics interfaces.
 7. Fire alarm zone schedules, designations and descriptions.
 8. Conduit type and routing.
 9. Fire alarm riser diagram.
 10. Point-to-point wiring schematics between the panel and all devices.
 11. Device addresses.
 12. Location of walls, partitions, sound attenuation materials, and other building construction features that affect placement of fire alarm system components.
 13. Sprinkler and special extinguishing system points to be monitored (water flow switches, water pressure switches, special agent discharge, valve tamper, etc.).
 14. Air handling plenums with smoke detection/shutdown.
 15. Components interlocked with the fire alarm system, such as elevators, dampers, fire doors, smoke doors, special extinguishing systems.
 16. Sequence of operation logic diagram or narrative description.
 17. Battery calculations.

5.0 SPECIAL EXTINGUISHING SYSTEMS

- A. Special extinguishing systems include both water- and nonwater-based systems arranged specifically to protect a particular hazard. These systems include:
1. Clean agent
 2. CO₂
 3. Deluge
 4. Dry chemical
 5. Foam
 6. Foam-Water

7. Preaction
- B. The special extinguishing system designer should prepare working plans that show the features described in the appropriate NFPA codes, including NFPA 11, NFPA 11A, NFPA 12, NFPA 15, NFPA 16, NFPA 17, NFPA 17A, NFPA 18, and NFPA 2001. Include in the plans all structural details that could have an effect on nozzle positioning. This would include the geometry of the room and the hazard being protected.
- C. Include complete information on the detection systems, including types of detectors, locations of detectors, and control logic for alarm and agent release. Also include wiring schematics and calculations for battery back-up power. Calculations for the extinguishing agent itself are usually prepared separately from the plans.

6.0 SPRINKLER SYSTEMS

- A. The sprinkler system designer should prepare working plans that show the features listed in NFPA 13, Section 8-1, Working Plans. When inside standpipes and/or hose are included in the project, also include the relevant information from NFPA 14.
- B. Elements to be included in the plans are:
 1. Sprinkler head information: makes, models, manufacturer, date of manufacture, type, temperature rating, K-factor, RTI, pendent/upright/sidewall, etc.
 2. Sprinkler head locations.
 3. Number of each type of sprinkler, number of sprinklers per floor, and total number of sprinklers.
 4. Pipe type, sizes, lengths, and locations.
 5. Dimensions between sprinkler heads, between branch lines, and from end sprinkler heads to the nearest wall(s).
 6. Types, sizes and locations of all fittings.
 7. Locations of low point drains.
 8. Types, sizes, and locations of all valves, including control (shut-off) valves, alarm check valves, dry pipe valves, backflow preventers, etc.
 9. Point of connection to existing sprinkler systems.
 10. Locations of hydrants and fire department connections.
 11. All auxiliary piping and trim, including piping to water motor gongs, and all drains and inspector's test connections.
 12. Capacity in gallons of dry pipe systems.
 13. Pitch of all piping for dry systems.
 14. Hydraulic design, hydraulic reference points, outline of the calculated areas, and hydraulic demands for nameplate data. (Sprinkler hydraulic calculations are usually prepared separately from the plans.)
 15. Locations of water flow alarms and valve tamper devices
 16. Locations of hose connections and standpipes

17. Elevations of pipes and sprinklers above finished floor
 18. Earthquake bracing (Seismic calculations are usually prepared separately from the plans.)
- C. Include in the plans all structural details that could have an effect on sprinkler head positioning. This would include, but not be limited to, beams, drop ceilings, soffits, full- and partial-height partitions, and any other potential obstructions to sprinkler discharge. Show structural details in elevation or isometric view, or on plan views with elevations called out.

7.0 WATER SUPPLIES

- A. Incorporate in plans for fire protection water supplies the information from the appropriate NFPA codes, including NFPA 13, NFPA 14, NFPA 20, NFPA 22, and NFPA 24. Include plans for the following:
1. Underground Mains in streets and at facility
 2. Pumps
 3. Tanks
 4. Hydrants
 5. Control and sectional valves

8.0 OTHER SYSTEMS

- A. Life safety analysis, including egress routing and determination of travel distances, will normally be shown in the Architectural drawing set.
- B. Fire and smoke dampers for building HVAC systems, access doors to HVAC dampers, ventilation systems for areas containing vapors, and smoke control systems will normally be shown in the Mechanical drawing set. Fuel-fired equipment will also be in the Mechanical set.
- C. Lightning protection, building and process back-up power systems, and electrical equipment for hazardous areas will normally be shown in the Electrical drawing set.
- D. Process Safety Controls, including P&IDs, will normally be shown in the Instrumentation and Controls drawing set.

9.0 ATTACHMENTS

ATTACHMENT 1: HISTORICALLY USED DRAWING NUMBERS

ATTACHMENT 2: EXISTING FACILITY MODIFICATION PROCESS GUIDANCE

10.0 APPENDICES

APPENDIX A: GENERAL – PLOT LIMITS, TXT CONVERSIONS, LINE TYPES CHART

APPENDIX B: GENERAL SYMBOLS CHART

APPENDIX C: CIVIL SYMBOLS CHART

APPENDIX D 1-3: FIRE PROTECTION SYMBOLS CHART

APPENDIX E 1-3: MECHANICAL SYMBOLS CHART

APPENDIX F 1-3: ELECTRICAL SYMBOLS CHART

APPENDIX G 1-4: P&ID AND PFD SYMBOLS CHART

APPENDIX H: TITLE BLOCKS AND TITLE SHEET INFORMATIONAL CHART

APPENDIX I: ARCHITECTURAL SYMBOLS CHART

APPENDIX J: PLUMBING SYMBOLS CHART

APPENDIX K: WELDING SYMBOLS CHART

ATTACHMENT 1

HISTORICALLY USED DRAWING NUMBERS (Do not use where these conflict with Section 210)

- **Engineering Change Notice:** This is a short form for initiating, developing, approving designs, and implementing drawing revisions.
- **Plate:** A formalized drawing varying in size from 11 x 17 to 24 x 36 inches electronically used in engineering studies, design criteria's, and conceptual design reports.
- **Sketch:** An informal rough drawing that may be hand drawn or electronically created that is not subject to drafting standard quality review procedures and vary in size from 8 1/2 x 11 to 24 x 36 inches
- **As-Built Number (AB#):** Related to the LANL JCNNM As-Built Program, this number appears in the title block of generated facility floor plans. The number is located where the traditional "C" appears; see Section 202 of this manual (e.g., AB345).
- **Construction Number (C#):** A unique number assigned to new facility construction projects. The number appears in the title block of each drawing, see Section 202 (e.g., C#22793)
- **Engineering Change Notice Number (ECN#):** The number assigned to an ECN by the facility manager (e.g, ECN# 53-TA-000005).
- **Plate Number (PL#):** A unique number assigned to a plate (e.g., PL#3746).
- **Project Identification Number (PI#):** A unique number assigned to LANL projects for tracking purposes found on documents (e.g., title blocks on drawings section, PI#100331).
- **Record Number (R#):** (Not used since 1991).
- **Sketch Number (SK#):** A unique number assigned to a sketch that is in plain view, usually located in a title block. The sketch number starts with the technical area and building number (e.g., SK-03-29-012).
- **Standard Detail Number (ST#):** A unique number assigned to a detail in the LANL Engineering Manual (e.g., ST6130).

ATTACHMENT 2

EXISTING FACILITY MODIFICATION PROCESS GUIDANCE

- A. **Condition I:** Existing facility with no electronic baseline drawings available:
- Acquire ECN form and ECN number from FM or FWO-IBS DCRM Team.
 - Research existing documents and electronically generate baseline drawings as required.
 - Reflect project scope of work on electronic drawings (i.e., demolition, new construction to existing facility, etc.).
 - Issue project for construction.
 - As-Built project, (convert line type, line widths, per Section 102.5.F of this manual)
 - Identify project drawings by Sheet Numbering System found in Sections 210 and 211.
 - Submit to FWO-IBS DCRM Team (all submitted electronic drawings shall conform to the requirements set forth in this manual).
- B. **Condition II:** Existing facility with electronic baseline drawings available:
- Acquire ECN form and ECN number from FM or FWO-IBS DCRM Team.
 - Generate drawing set via sketches and sketch numbers to reflect scope of work (i.e., demolition, new construction to existing facility, etc.)
 - Issue project for construction.
 - As-Built project, (convert line type, line widths, per Section 102.5.F of this manual)
 - Identify project drawings by Sheet Numbering System found in Sections 210 and 211.
 - Submit to FWO-IBS DCRM Team (all submitted electronic drawings shall conform to the requirements set forth in this manual).
- C. **Condition III:** Existing facility has baseline drawings in FWO-IBS DCRM database.
- Design agency should acquire copies of drawings on-line from database.
 - Incorporate project changes by ECN process, using Drafting Manual requirements.
 - As-Built the drawings (incorporate conversion process per Section 102.5.F of this manual).
 - Submit to FWO-IBS DCRM Team (all submitted electronic drawings shall conform to the requirements set forth in this manual).